ENTACT

Appendix F

Appendix F

BASELINE ECOLOGICAL RISK ASSESSMENT
for the Former American Zinc Plant Site
Fairmont, City, Illinois

Prepared by
Terry Bosko
M.T. Bosko and Associates, LLC.

On behalf of
ENTACT & Associates, LLC

August 2008

Baseline Ecological Risk Assessment
Old American Zinc Plant Site
Fairmont City, Illinois

TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY

1.0 INTRODUCTION 1
1.1 APPROACH 1
1.2 REPORT ORGANIZATION 3
2.0 SITE CHARACTERISTICS 4
2.1 PHYSICAL SETTING 4
2.2 SITE HYDROLOGY AND DRAINAGE 4
2.2.1 Facility Area Ditches 5
2.2.2 Rose Creek 6
2.2.3 Schoenberger Creek 6
2.2.4 Old Cahokia Watershed 7
2.3 ECOLOGICAL SETTING 8
2.3.1 Facility Area Ditches 8
2.3.2 Rose Creek 9
2.3.3 Old Cahokia Watershed 10
2.3.3.1 West Ditch Outfall 11
2.3.3.2 Rose Creek Outfall 12
2.3.4 Schoenberger Creek 12
3.0 PROBLEM FORMULATION 13
3.1 COPEC FATE AND TRANSPORT AND ECOTOXICITY 13
3.2 COMPLETE EXPOSURE PATHWAYS AND CONCEPTUAL SITE MODEL 15
3.3 ASSESSMENT AND MEASUREMENT ENDPOINTS 16
4.0 ECOLOGICAL FIELD INVESTIGATIONS 17
4.1 SEDIMENT AND SURFACE WATER CHEMISTRY 17
4.2 WHOLE SEDIMENT BIOASSAYS 18
4.2.1 Bioassay Sediment Sample Collection 18
4.2.2 Bioassay Laboratory Methods 18
4.3 TISSUE RESIDUE STUDIES 19
4.3.1 Macroinvertebrate Tissue 19
4.3.2 Plant Tissue 20
4.4 COMMUNITY STUDIES 21
4.4.1 Macroinvertebrate Community 21
4.4.2 Wetland Plant Community 22
5.0 CHARACTERIZATION OF EXPOSURE AND EFFECTS 24
5.1 CHARACTERIZATION OF EXPOSURE 24
5.1.1 Sediment and Surface Water Chemistry 24

5.1.2 Bioassays ... 28
5.1.3 Tissue Residue Studies ... 29
5.1.3.1 Wetland Plants ... 30
5.1.4 Community Studies ... 30
5.1.4.1 Macroinvertebrates ... 31
5.1.4.2 Wetland Plant Community ... 31
5.2 CHARACTERIZATION OF EFFECTS ... 31
5.2.1 Sediment and Surface Water Chemistry ... 32
5.2.2 Bioassays ... 34
5.2.3 Tissue Studies ... 35
5.2.4 Community Studies ... 36
5.2.4.1 Macroinvertebrates ... 36
5.2.4.2 Wetland Plant Community Study ... 38
6.0 RISK CHARACTERIZATION ... 40
6.1 RISK ESTIMATION ... 40
6.1.1 Sediment and Surface Water Chemistry ... 40
6.1.2 Bioassays ... 44
6.1.3 Tissue Analysis ... 45
6.1.4 Community Studies ... 47
6.1.4.1 Macroinvertebrates ... 47
6.1.4.2 Wetland Plants ... 49
6.2 UNCERTAINTY ANALYSIS ... 50
6.3 RISK DESCRIPTION ... 52
7.0 REFERENCES ... 57

TABLES

Table 3-1 Assessment and Measurement Endpoints

Table 4-1 Summary of Surface Water and Sediment Samples Collected for Chemical Analyses
Table 4-2 Summary of YSI Readings
Table 4-3 Summary of Bioassay Sediment Sample Locations
Table 4-4 Physical Appearance of Sediment Collected for Bioassays
Table 4-5 Benthic Tissue Sample Composition
Table 4-6 Summary of Aquatic Macro-Invertebrate Community Sampling Locations

Table 5-1 Concentrations of 8 RCRA Metals, Copper, Zinc and Detected Pesticide Compounds in Sediment Samples Compared to Ecological Screening Levels
Table 5-2 Concentrations of Total and Dissolved Metals and Detected Organic Compounds in Surface Water Samples Compared to Ecological Screening Levels
Table 5-3 Physical Appearance of Sediments and Bioassay Results
Table 5-4 Summary of Analyses of Benthic Macro-Invertebrate Tissue Samples
Table 5-5 Summary of Analyses of Plant Tissue Samples
Table 5-6 Benthic Macroinvertebrate Community Analysis
Table 5-7 Benthic Macroinvertebrate Community Indices
Table 5-8 Summary of Plant Community Study

Table 6-1 Summary of PEC-Quotients for Metals in Sediment Samples
Table 6-2a Concentrations of Dissolved Metals in Surface Water Samples Compared to IEPA Water Quality Criteria
Table 6-2b Calculation of Hardness-Dependent Aquatic Life Standards
Table 6-3 Benthic Macro-Invertebrate Tissue Samples Compared to Tissue Residue Effect Levels
Table 6-4 Lines of Evidence for Assessing Impacts on Aquatic Ecosystems
Table 6-5 Maximum and Mean Hazard Quotients (HQ) for Estimated Benthic Invertebrate Tissue Concentrations

FIGURES

Figure 1 Facility Location
Figure 2 Surface Water Features shown on the 2004 Ortho-Rectified Aerial Photograph
Figure 3 Ecological Sample Location Map
Figure 4 Ecological Conceptual Site Model
Figure 5 Regression Analyses of Benthic Tissue and Sediment Concentrations

ATTACHMENTS

Attachment A Site Photographs
Attachment B Bioassay Laboratory Results
Attachment C Benthic Community Study
Attachment D Vegetation Community Study
Attachment E ERED Database
Attachment F Calculation of PEC Quotients and Estimated Tissue Concentrations

1.0 INTRODUCTION

The objective of the baseline ecological risk assessment (BERA) is to determine whether chemicals associated with the Old American Zinc Plant Site (Site) in Fairmont City, Illinois found in wetland soils, sediments and/or surface water pose a current or potential future risk to populations of aquatic receptors, including macroinvertebrates and plants. An ecological survey (described in Subsection 1.3) found no state or federally listed Threatened and Endangered (T&E) plant or animal species or suitable habitat for these species on or surrounding the Site. In accordance with the Administrative Order of Consent (AOC), because no terrestrial T&E species were identified the BERA only has to address the aquatic ecosystem that may potentially have been affected by smelter-related contaminants.

To meet this objective, the BERA:

- Evaluates heavy metal levels in sediment, surface water, and macroinvertebrate and wetland plant tissue;
- Assesses the potential for adverse impact to ecological receptors, focusing on exposures to aquatic invertebrate and wetland plant communities; and,
- Develops conclusions and recommendations based on the findings of the BERA.

The results of the BERA will be utilized in the Feasibility Study (FS) to propose risk-based standards applicable to the Site and to define the appropriate response alternatives, if any.

1.1 APPROACH

The methodology used to assess the potential ecological risks at the Site draws upon guidance set forth in the following documents:

- *Framework for Ecological Risk Assessment* (EPA, 1992a). EPA/630/R-92/001.
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments - Interim Final* (EPA, 1997). EPA 540-R-97-006.
- *Guidelines for Ecological Risk Assessment* (EPA, 1998). EPA/630/R-95/002F.
- *Ecological Risk Assessment and Risk Management Principles for Superfund Sites* (EPA, 1999). OSWER Directive 9285.7-28P.
- *Superfund Ecological Risk Assessment 8-step Overview* (EPA, 2005). Last updated on Monday, January 3, 2005.
  URL: http://www.epa.gov/region5superfund/ecology/html/8stepera.html

- *Sediment Classification Methods Compendium (*EPA, 1992b). EPA 823-R-92-006.

The United States Environmental Protection Agency's (EPA's) *Framework* document (1992a) defines an ecological risk assessment (ERA) as a process that evaluates the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to one or more stressors. EPA (1997) has developed an eight-step ERA process for Superfund that is based on this ecological risk assessment framework. The steps are:

Step 1: Screening Level Problem Formulation and Ecological Effects Evaluation
Step 2: Screening Level Preliminary Exposure Estimate and Risk Calculation
Step 3: Baseline Risk Assessment Problem Formulation
Step 4: Study Design and Data Quality Objectives
Step 5: Field Verification of Sampling Design
Step 6: Site Investigation and Analysis of Exposure and Effects
Step 7: Risk Characterization
Step 8: Risk Management

The first two steps in the assessment process are streamlined versions of the complete framework process and are intended to allow a rapid determination that a site poses no or negligible risks, or to identify which chemicals and which exposure pathways require further evaluation. A screening level ecological risk assessment (SLERA) was completed for this Site during the development of the Support Sampling Plan (SSP) for the Site (ENTACT, 2006). This SLERA identified the need to conduct further assessment of potential risks posed by heavy metals to specific aquatic receptors. Specifically, historic data revealed the presence of sediments at the Site that contained concentrations of heavy metals in excess of sediment-quality benchmarks. Macro-invertebrate fauna and plants inhabiting the ditches, streams, and wetlands that receive runoff from the area of the former smelter facilities (Facility Area) may, therefore, become exposed to the heavy metals present in these sediments at concentrations that could result in potential ecological risks. Therefore, the BERA prepared for the Site addresses potential risks to aquatic plants and aquatic macro-invertebrates resulting from the presence of heavy metals within surface waters and sediments.

Steps 3 through 7 in the framework are a more detailed version of the ecological risk assessment framework, and these are the steps that were followed for preparing the BERA for the Site. The following subsections present the steps performed for this BERA, following EPA Region 5 guidance (EPA, 2005).

1.2 REPORT ORGANIZATION

This report consists of the following sections:

- Section 1: Introduction – This section presents an introduction to the Site, objectives, approach, and the organization of the report.

- Section 2: Site Characteristics – This section presents a description of the Site and describes Site-specific field investigations conducted to support the BERA.

- Section 3: Problem Formulation – This section presents the first four required elements of the BERA: the chemical of potential ecological concern (COPEC) screening analysis, an exposure pathway analysis, a conceptual exposure model, and a COC fate and transport analysis. Assessment and measurement endpoints are also selected.

- Section 4: Ecological Investigations – This section presents a description of the field studies performed to support the BERA, which included sediment and surface water sampling, laboratory bioassays, tissue sampling, and community studies.

- Section 5: Characterization of Exposure and Ecological Effects – This section presents the characterization of exposure, which identifies the magnitude and frequency at which target receptors may potentially be exposed to COPECs that have migrated or that may potentially migrate via complete exposure pathways to the ecological habitat at the Site. This section also presents information on the toxicity of the COPECs to ecological species, including bioassays/toxicity assessment and bioaccumulation studies.

- Section 6: Risk Characterization – This section presents the risk estimation and risk description which integrates the information from the problem formulation and the exposure and ecological effects characterizations to estimate the nature and extent of potential ecological risk. This section also summarizes those factors that significantly influence estimates of potential risk, evaluates their range of variability, and assesses the contribution of these factors to the under- or over-estimation of potential risk.

- Section 7: References- This section presents the citations of the literature referenced in the BERA.

All tables and figures presented in this report are located at the end of each respective section.

2.0 SITE CHARACTERISTICS

A physical and biological description of the Site and information on the areas on or adjacent to the Site that contain ecological receptors and habitat are described in this section.

2.1 PHYSICAL SETTING

The former smelting operations at the Site were conducted on the 132-acre Facility Area located within the southeast quarter of Section 4, Township 2 North, Range 9 West, St. Clair County, Illinois,. The Facility Area location and surrounding area topography are illustrated in Figure 1. The Facility Area is currently inactive, and surrounded by a chain-linked perimeter fence with locked entrance gates along the eastern and southern boundaries.

The Facility Area is bordered by Kingshighway to the east, 45th Street to the west, Maryland Avenue to the north, the Cargill Facility (formerly Swift Agricultural Chemical Corp.) to the southeast, and CSX Intermodal and the Penn Central and Baltimore/Ohio railroad corridor to the south, as illustrated in Figure 1. Residential properties lie to the immediate north and northeast of the Facility Area, and commercial and industrial properties lie to the immediate east, south and west. Collinsville Road, a four-lane highway, lies approximately 0.12 miles north of the Facility Area and to the immediate south of a large wetland complex known as the Old Cahokia Watershed.

As the focus of the BERA is limited to the aquatic ecosystem that may have been affected by smelter-related chemicals, this discussion regarding Site setting is limited to the aquatic features on and downgradient of the Facility Area.

2.2 SITE HYDROLOGY AND DRAINAGE

The surface water drainage on and downgradient of the Facility Area is shown on Figure 2. Surface water drainage over the majority of the Facility Area flows in a southwesterly direction to Rose Creek via a series of ephemeral ditches. Rose Creek, another ephemeral drainage flows in a westerly direction from the Facility Area, discharging to the Old Cahokia Watershed at a point approximately ¾ mile west of the Facility Area. The northwestern portion of the Facility Area is drained by a ditch along the western boundary of the Facility Area, which carries and surface water runoff from this area of the Facility Area northward directly to the Old Cahokia Watershed at a point approximately ¼ mile north of the Facility Area.

The Old Cahokia Watershed included in the investigation area encompasses approximately more than 1,500 acres to the north and west of the Facility Area across Collinsville Road, as illustrated in Figure 2. The watershed is drained in part by a remnant section of Cahokia Creek, and an engineered drainageway (herein referenced as the Engineered Drainage Ditch), which channels water from the drainage of the Milam Landfill and Interstate 55 to Schoenberger Creek, the watershed outlet point, located approximately 1,500 feet west of the Rose Creek Outfall location. This engineered drainageway hydraulically connects Rose Creek to Schoenberger Creek.

Section 1.1.1.3 of the Remedial Investigation (RI) report presents a detailed description of the drainage features on and downgradient of the Facility Area. These descriptions are reiterated herein for the convenience of reference.

2.2.1 Facility Area Ditches

The Facility Area is drained by a set of four drainage ditches; two located in the eastern portion of the Facility Area, designated as East Ditch #1 and East Ditch #2, and two located in the western portion of the Facility Area, designated as West Ditch #1 and West Ditch #2. The locations of these drainage ditches are illustrated in Figure 2. These ditches are shallow and ephemeral; they lie above the water table, receive no base flow, and only flow in direct response to a precipitation event. During periods of no precipitation, the ditches consist of isolated pools of stagnant water separated by segments of dry ditch. During the summer these pools get very warm and anaerobic, and are prone to temperature extremes and depleted oxygen levels (refer to Subsection 4.1).

East Ditch #1 begins at the eastern edge of the Facility Area east of the XTRA buildings, and continues approximately 2,200 feet in a southwesterly direction across the far eastern portion of the Facility Area until it flows into Rose Creek near the southeastern corner of the Facility Area. This ditch is bermed with spoil and/or slag, and consisted of pooled, stagnant water throughout its entire length during all the sampling events. East Ditch #2 begins at Kingshighway north of the Cargill Property and extends west for approximately 800 feet to its confluence with East Ditch #1, approximately 600 feet upstream of Rose Creek (Figure 2). East Ditch #2 is very shallow and heavily vegetated, and during drier periods holds no standing water. There are no distinct bordering spoil banks along this ditch

The western and northwestern portions of the Facility Area are drained by a West Ditch #1, which runs along the western border of the Facility Area and thence along Maryland Avenue, where it is channeled through a culvert beneath Collinsville Road, discharging to the Old Cahokia Watershed at a point, referenced as the West Ditch Outfall, approximately ¼ mile north of the Facility Area (Figure 2). West Ditch #1 consists of a narrow, shallow swale, and does not possess any distinct bordering spoil banks. The southern portion of this ditch passes through a wooded area and discharges to Rose Creek at the southwestern corner of the Facility. The remainder of the ditch discharges to the West Ditch Outfall in the Old Cahokia Watershed. West Ditch #2 is located in the southwestern corner of the Facility Area and is a narrow, very shallow, 800-foot long, erosional swale that discharges to Rose Creek via a culvert outfall at the extreme southwestern corner of the Facility Area.

The sediments in the dry sections of the Facility ditches generally consist of silty clays with varying amounts of organic matter and in some instances, most notably the southern portion of East Ditch #1 and the central portions of West Ditch #1, visible pieces of slag. Sediments in the northern portion of East Ditch #1 possessed a large amount of dead and decaying plant matter.

2.2.2 Rose Creek

Rose Creek is a shallow, ephemeral stream which flows in a westerly direction along the south edge of the Facility Area. Prior to entering the Site, Rose Creek flows along the southern boundary of the General Chemical facility, crossing beneath Kingshighway and along the Cargill facility's southern boundary (Figure 2). Rose Creek flows westerly along the Facility Area's southern boundary and then continues in a general westerly direction along the northern side of the CSX railroad corridor. It is diverted via a culvert beneath Collinsville Road where the creek discharges to the Old Cahokia Watershed at a point, referenced as the Rose Creek Outfall, approximately ¾ mile west of the Facility Area's western boundary (Figure 2).

Like the drainage ditches, Rose Creek is ephemeral and only flows in direct response to precipitation events. During periods of no precipitation, Rose Creek consists of isolated pools of stagnant water separated by segments of dry creek bed. During the summer these pools get very warm and anaerobic.

Sediments in Rose Creek consist largely of silty clays with some organic matter. The stretch of creek along the southwest corner of the Facility Area contained a surficial layer of fine organic silty muck and distinct pieces of slag.

2.2.3 Schoenberger Creek

Schoenberger Creek is located south of the Facility Area (Figure 2). The creek flows in a westerly direction before it is diverted north through a culvert under Collinsville Road into the Old Cahokia Watershed. The Creek continues north through the watershed for approximately 1,400 feet and then trends westerly. The Creek is channelized at this point, and hydraulically isolated from the wetlands of the Watershed via border spoil banks. The Old Cahokia Watershed discharges into Schoenberger Creek via two culverts at points just north of Collinsville Road. Schoenberger Creek continues to flow west for approximately 0.6 miles where it converges with a tributary of the Cahokia Canal. According to a 1998 United States Geological Survey (USGS) aerial photograph, the tributary flows north to Cahokia Canal, which discharges into the Mississippi River approximately 3 miles downstream of the point where the Old Cahokia Watershed discharges into Schoenberger Creek.

2.2.4 Old Cahokia Watershed

The Old Cahokia Watershed consists of a complex of wetlands and stagnant, standing water, man-made ponds, and isolated upland areas located between Collinsville Road to the south, Illinois Highway 111 (Kingshighway) to the east, Interstate 55/70 (I-55/70) to the north, and Illinois Highway 203 to the west. Two creeks traverse the east and western portion of the Watershed, Old Cahokia Creek and Schoenberger Creek. The two creek channels are separated from each other by distance (approximately 1,000 feet) and a levee, which was constructed between 1907 and 1915 and later improved by the U.S. Army Corp of Engineers under the Flood Control Act of 1936. The two creek channels and the connecting engineered drainageway are illustrated in Figure 2.

Prior to reaching the Old Cahokia Watershed, Schoenberger Creek is hydraulically separated from the Facility Area both topographically and through intervening manmade barriers as illustrated in Figure 2. These barriers include an expansive rail corridor, a natural bluff along the north side of Washington Park (immediately south of the rail corridor), numerous streets and residential properties, as evident in Figure 2.

Historically, much of the Watershed was drained and used for agricultural purposes. Old Cahokia Creek previously drained the Watershed before flowing south through East St. Louis and discharging to the Mississippi River at a point approximately 3 miles south-southwest of the Facility Area (Fenneman, 1910). Development, construction of I-55/70 in the early 1960s, and the expansion of the Milam Landfill have significantly altered the natural drainage in this area. The Old Cahokia Creek channel is clearly identified in the 1968 aerial photograph on both sides of I-55/70. The 2004 aerial photograph (Figure 2) shows an expanded landfill area and a series of ponds on the north side of I- 55/70, with Old Cahokia Creek truncated on the north side of I-55/70. According to an Illinois State Geological Survey (ISGS) study, the creek drainage now flows west through a series of ponds along the northern side of I-55/70 (ISGS, 2003). The drainage from this area then flows back through a second culvert under I-55/70 and into the Engineered Drainage Ditch. The Engineered Drainage Ditch located in the western portion of the Watershed is evident in the earliest aerial photographs of the area (1950), and presumably served to channel drainage from these agricultural fields. This structure still serves to drain the western portion of the Watershed.

An 80-acre golf course was located north of Collinsville Road in the south-central portion of the Watershed. The golf course, constructed in 1949, used earthen berms on the western and eastern portions of the parcel to prevent inundation of the area. The golf course appears in historical aerial photographs from 1950 through 1993. Sometime after 1993, the golf course was abandoned.

During the period between 1978 and 1988, much of the agricultural and fallow lands in the Watershed were inundated. In 2003, the ISGS reported on the results of a study to determine if the former golf course could be converted into a potential wetland compensation area. The ISGS recommended removing the eastern berm to restore the golf course to wetland conditions (ISGS, 2003). The former golf course area and the slope of the terrace along the watershed's southern boundary are the only areas within the Watershed which are not mapped as either a National Wetland Inventory (NWI) wetland or a Permanent or Semi-permanent Inundation Area. However, recent direct observation indicates that the former golf course area contains wetland habitats.

Information obtained by ENTACT from Illinois Environmental Protection Agency (IEPA) files indicated that the illegal dumping of drums of industrial wastes occurred in the area south of Old Cahokia Creek and northeast of the golf course in the early 1970s. A removal action was conducted in August 1984 that entailed the removal of these drums and some visibly impacted surface soils.

Surface water runoff from the Facility Area enters the Watershed at two outfall points, the West Ditch Outfall and the Rose Creek Outfall. These are described further in Subsections 2.3.6 and 2.3.7, respectively. The West Ditch outfall is located in the eastern portion of the Old Cahokia Watershed (Figure 2). The outfall drains to a small wet meadow and marshland area located north of Collinsville Road. The Rose Creek Outfall is located in the western portion of the Old Cahokia Watershed (Figure 2). The outfall drains to a scour channel that drains to a wetlands area located south of the historic location of the Engineered Drainage Ditch.

Standing water within the wetlands and open water habitats is largely stagnant, with very little if any flow. The standing water is shallow, generally two feet or less in depth. Sediments within these habitats generally consisted of highly organic, anaerobic/septic mucks underlain by very dense, plastic grey clays.

2.3 ECOLOGICAL SETTING

The following subsections describe the ecological setting of the ephemeral drainage features, wetlands and water bodies at the Site. Photographs of these areas are presented in Attachment A.

2.3.1 Facility Area Ditches

The vegetation within and bordering the Facility Area ditches consist of disturbance tolerant or ruderal (weedy and adventive) species. Sections of East Ditch #1 retain ponded water throughout all or much of the year, and support ruderal populations of aquatic vegetation, and macro-invertebrates. The remaining three Facility Area drainage ditches do not retain any standing water during the drier parts of the year, and do not support any such aquatic populations.

The northern stretch of East Ditch #1, extending from its northern terminus near the east side of the Facility southward to the confluence of East Ditch #2 (Figure 2), supports floating, emergent, and submerged aquatic vascular vegetation including grasses, duckweed (*Lemna*), arrowhead (*Sagittarius*), pondweed (*Potamogeton*), water purslane

(*Ludwigia*), and filamentous algae within the bed of the ditch. The water column is shallow, typically less than one foot in depth. The bordering spoil banks are pronounced and consist of soil and slag-like granular fill, and are generally well vegetated with forbs and weeds, and occasional shrubs. The southern stretch of East Ditch #1, extending from this confluence south to Rose Creek, also holds stagnant water; however, the presence of vascular aquatic vegetation is noticeably reduced, while the presence of submerged algal mat increases. The areas bordering this section of the ditch are covered with slag and slag-like granular fill, and sparse growth of ruderal grasses and forbs.

East Ditch #2 is a shallow ephemeral swale which is heavily vegetated with grasses, forbs and woody shrub, sapling, and tree growth. This ditch holds no standing water during drier periods of the year.

The southern section of West Ditch #1, extending from the south side of the Facility Area approximately 700 feet to the north, consists of a dry ephemeral swale within a heavily wooded area of mature trees. The northern section, extending from this wooded area to the northwest corner of the Facility Area, is also a shallow swale overgrown with grass, and forbs. Some isolated, very small pools of stagnant water, and isolated pockets of cattails (*Typha*) and common reed (*Fragmities*) exist within the bed of the central section of West Ditch #1. The areas bordering the ditch on the Facility Area possess a large amount of demolition debris and exposed slag and slag-like granular fill. They are sparsely vegetated if at all, with grasses and forbs, and some isolated sapling/small tree growth. That section of West Ditch #1 extending off of the Facility Area north to Collinsville Road consists of an open ephemeral grassed swale, or is diverted through a sub-grade storm sewer.

West Ditch #2 consists of a dry ephemeral swale within an area dominated by small ruderal trees and forbs, and isolated colonies of common reed and cattails. Some isolated ponding may persist near towards the northern terminus of the ditch during parts of the year.

2.3.2 Rose Creek

Upstream of the Facility Area, Rose Creek consists of a shallow swale sparsely vegetated with grasses, forbs and some woody shrub, sapling, and small tree growth. The section of Rose Creek bordering the southeast and south-central portions Facility Area typically holds standing water even during the direr portions of the year, with this pooled water being contiguous with pooled water present in the southern portion of East Ditch #1. There is very little vascular aquatic vegetation present in this pool, the majority of the vegetation present consists of submerged algal mats. The Creek is bordered by a spoil bank of slag, slag-like granular fill and soil which are sparsely vegetated with ruderal forbs. Progressing westward, the spoil banks begin to level out to the surrounding grade, and the banks of the ditch quickly become heavily vegetated with forbs, shrubs and trees. These trees eventually form a canopy over the ditch. The depth of water steadily decreases, until standing water is present only within intermittent pools along the western end of the south side of the Facility Area.

Downstream of the Facility Area, Rose Creek consists largely of a low scour channel with some isolated pooling of water. The creek is bordered by a narrow band of small ruderal trees which grade to mature deciduous woods occupying a distinct ravine near Collinsville Road. Some sections of the Creek possess a large amount of collected debris (dead fall and/or trash).

2.3.3 Old Cahokia Watershed

The Old Cahokia Watershed consists of a complex of wetlands and stagnant, standing water, man-made ponds/borrow pits, and isolated upland areas. The open water and wetlands are largely of recent origin, having been created within the last 30 or so years from formerly drained agricultural lands, wooded areas, and a golf course. The floral communities present in these wetland and aquatic habitats contain a large percentage of ruderal/adventive species.

The Watershed possesses three principal drainage features; remnant portions of Cahokia Creek, the Engineered Drainage Ditch, and a small section of Schoenberger Creek (Figure 2). Remnant sections of Cahokia Creek, a perennial stream, exist in the northeast portion of the Watershed Area. This Creek drains the eastern portion of the Watershed to the north via a culvert underlying Interstate 70/55. The Engineered Drainage Ditch is an historic, man-made drainage channel which likely served to drain agricultural lands in the western portion of the Watershed. Schoenberger Creek is a perennial stream that receives drainage from wetlands in the far southwestern portion of the Watershed.

A large portion Watershed consists of various wetland habitats, as well as some associated open water habitat. The area located between Cahokia Creek and Collinsville Road in the eastern portion of the Watershed contains a large open water habitat bordered by cattail marsh, particularly to the south, and buttonbush (*Cephalanthus occidentalis*) and wooded swampland to the north and west. The open water habitat possesses submerged, floating and low emergent vegetation, which was dominated by water primrose (*Ludwigia*). Pennywort (*Hydrocotle*), knotweed (*Polygonum*), cattails, and buttonbush are dominant along the edges of this habitat. Remnants of north-south trending hedgerows that had separated former agricultural fields are evident in the Watershed. Some large snags are present, and are particularly prevalent in the eastern extent of the Complex, near Highway 111.

The area generally situated between the Engineered Drainage Ditch and Cahokia Creek, including the former golf course and former agricultural fields, also consists of a complex of shallow open water habitat, marshes, and wooded swampland.

That northwestern portion of the Watershed is slightly more elevated than the remainder of the Watershed, and contains man-made lakes (former borrow pits), wetlands and scattered woodlands. The four man-made lakes, ranging in size from approximately 3 to 7 acres, are located off of an access road paralleling Interstate 70/55, west of the Engineered Drainage Ditch. (Note for sake of reference, these four lakes are referenced herein as A, B, C and D, proceeding from west to east, within the photographs presented in Attachment A).

The southwestern portion of the Watershed is largely wetland habitat, dominated by expansive growth of cattails and sedges, with some isolated colonies of common reed. Open water exists in the area just north of Collinsville Road and east of Schoenberger Creek. The Engineered Drainage Ditch extends through this wetland area, terminating near this open water. The Ditch is a shallow channel generally 1 to 2 feet in depth, typically bordered by cattail marsh.

The Watershed receives surface water drainage from the Facility Area at two outfall locations, the West Ditch outfall and the Rose Creek outfall. These areas are detailed below.

2.3.3.1 West Ditch Outfall

The West Ditch #1 outfall drains to Old Cahokia Creek Watershed via a culvert located in a deciduous wooded area along the north side of Collinsville Road. A deep scour channel extends from this outfall north through a heavily wooded section of sloping land bordering the north side of the road. Less than 100 feet or so north of the outfall, the topography levels and the scour channel becomes shallower. The channel extends into a wet meadow covered by low forbs with scattered shrub and sapling growth. The wet meadow is situated between the woodland bordering Collinsville Road and the open water habitat located approximately 350 feet north-northwest of the outfall. The northeast side of the open meadow borders a small area of swampy habitat dominated by large trees, which opens further to the northeast into a marsh dominated by cattails. To the west and southwest, the open meadow changes to a small low-lying marsh area dominated by cattails, which borders a wooded swampy area further to the west.

A distinct flow path is evident through the southern portion of this meadow, but becomes less distinct and begins to fan out into smaller channels near the center of the meadow. The meadow will possess some very shallow standing water during wet portions of the year, but is typically dry.

Along the edge of the wet meadow and the open water habitat, two duck blinds and evidence of recent waterfowl hunting, including duck decoys and spent shotgun shells, were evident in the open water and meadow near these blinds.

2.3.3.2 Rose Creek Outfall

The Rose Creek outfall drains to Old Cahokia Creek Watershed via a culvert located in a deciduous wooded area along the north side of Collinsville Road. A deep scour channel extends from this outfall north through a heavily wooded section of sloping land bordering the north side of the road. An open area of grass and forbs is present roughly 140 feet downstream. A large expanse of common reed is located northwest of these woods, roughly 350 feet downstream of the outfall. A large pile of debris and branches, as well as two drum carcasses, were encountered in the wooded areas between these two open areas. The scour channel begins to fan out into a broad depositional area within a transitional zone of small willows along the wooded area

2.3.4 Schoenberger Creek

Schoenberger Creek in the vicinity of Collinsville Road is a channelized stream roughly 15 to 25 feet in width. The Creek appears to be a perennial stream; however, no discernible flow was observed during the sampling events. Floating and emergent vascular vegetation is present along the sides of the creek. This vegetation is particularly predominant on the stretch of the creek immediately upstream (south) of Collinsville Road. The spoil banks along the side of the creek are vegetated with grass and forbs that appeared to be maintained (mowed), or are covered with shrub and small tree growth.

3.0 PROBLEM FORMULATION

The problem formation establishes the goals, breadth, and focus of the BERA. The problem formulation for this Site involves identifying the exposure pathways by which COPECs have migrated or may migrate from the Facility Area and ultimately to link these routes of migration to receptors and habitat on and downgradient of the Facility Area. The problem formulation also establishes the assessment endpoints or specific ecological values to be protected. The questions that need to be addressed are defined based on potentially complete exposure pathways and ecological effects. A conceptual model of the Site is presented that shows the complete exposure pathways evaluated in the BERA. The relationship of the measurement endpoints to the assessment endpoints is also discussed.

Problem formulation was originally completed as part of the *BERA Workplan (*ENTACT 2006*)* development, and has been refined as new Site data were generated during the RI.

3.1 COPEC FATE AND TRANSPORT AND ECOTOXICITY

Concentrations of arsenic, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc were detected in sediments and surface water at concentrations exceeding Region V ecological screening levels (ESLs) and are considered COPECs at the Site (i.e., their potential to pose potential ecological risk needs to be further assessed during the BERA process). Summaries of the fate and transport properties of the COPECs and their potential toxicity based the Agency for Toxic Substances and Disease Registry (ATSDR) toxicity profiles (URL:http://www.atsdr.cdc.gov/toxpro2.html) are listed below:

Arsenic is a naturally occurring element widely distributed in the environment. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Arsenic cannot be destroyed in the environment and it can only change in oxidation state. Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful to the fish.

Barium is a silvery-white metal that takes on a silver-yellow color when exposed to air. Barium occurs in nature in many different forms including solids such as powders or crystals, and they do not burn well. In aquatic media, barium is likely to precipitate out of solution as an insoluble salt. Barium is not very mobile in most soil systems. There is information that barium bioconcentrates in certain plants and aquatic organisms.

Cadmium is a natural element in the earth's crust. It is usually found as a mineral combined with other elements (e.g., with oxygen as cadmium oxide, etc.). It binds strongly to soil particles. It does not breakdown in the environment, but can change forms. Some cadmium dissolves in water. Fish, plants, and animals take up cadmium in the environment. Cadmium stays in the body for a very long time and can build up from many years of exposure to low levels.

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different oxidation states; the most common forms are chromium III and VI. Chromium III is also considered to be an essential nutrient. Chromium has a strong affinity to soil and only a small amount dissolves in water. Fish do not appreciably accumulate chromium in their bodies from water.

Copper and its compounds are naturally present in the earth's crust. In aerobic sediments, copper is bound mainly to organics (humic substances) and iron oxides. However, in some cases, copper is predominantly associated with carbonates. In anaerobic sediments, Cu(II) will be reduced to Cu(I) and insoluble cuprous salts will be formed. In natural waters, copper is predominantly in the Cu(II) state, with most of it complexed or tightly bound to organic matter. Little is present in the free (hydrated) or readily exchangeable form. The combined processes of complexation, adsorption, and precipitation control the level of free copper (Cu(II)). The chemical conditions in most natural water are such that, even at relatively high copper concentrations, these processes will reduce the free Cu(II) concentration to extremely low values. Copper shows a low potential for bioconcentration in fish. There are limited data suggesting that there is little biomagnification of copper in the aquatic food, with biomagnification ratios less than one.

Lead is a naturally occurring metal which does not break down, but organic lead compounds change composition due to sunlight, air, and water. Lead has a high affinity to soil and sediment particles. Plants and animals may bioconcentrate lead, but lead is not biomagnified in the aquatic or terrestrial food chain.

Mercury is a naturally occurring metal which has several forms. Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds. Mercury also combines with carbon to make organic mercury compounds, the most common of which is methylmercury. Accumulation and toxicity of mercury in aquatic biota, domestic animals, and humans is well documented, but relatively little is understood about these processes in wild terrestrial mammals. Mercury levels are biomagnified within terrestrial food chains. Among carnivorous species, mercury levels are generally highest in fish-eating animals. Experimental studies have shown many mammal species are sensitive to mercury intoxication, but documented incidents of mercury poisoning in wild mammals are rare due to the inability to observe wild populations.

Selenium is ubiquitous in the environment, being released from both natural and anthropogenic sources. The primary factor determining the fate of selenium in the environment is its oxidation state. In general, elemental selenium is stable in soils and is found at low levels in water because of its ability to coprecipitate with sediments. The soluble selenates are readily taken up by plants and converted to organic compounds such as selenomethionine, selenocysteine, dimethyl selenide, and dimethyl diselenide. Selenium is bioaccumulated by aquatic organisms and may also biomagnify in aquatic organisms.

Silver is a naturally occurring metal found in the environment and combines with other elements such as sulfide, chloride, and nitrate. Silver does not appear to significantly concentrate in aquatic animals.

Zinc is an element commonly found in the Earth's crust. Zinc is capable of forming complexes with a variety of organic and inorganic groups (ligands). In the aquatic environment, zinc partitions to sediments or suspended solids in surface waters through sorption onto hydrous iron and manganese oxides, clay minerals, and organic material. Biological activity can affect the mobility of zinc in the aquatic environment, although the biota contains relatively little zinc compared to the sediments. Zinc bioconcentrates moderately in aquatic organisms; bioconcentration is higher in crustaceans and bivalve species than in fish. Zinc does not concentrate in plants, and it does not biomagnify through terrestrial food chains.

3.2 COMPLETE EXPOSURE PATHWAYS AND CONCEPTUAL SITE MODEL

Complete exposure pathways, which are the paths a COPEC takes from its source into the environment and ultimately to a receptor, have been identified and are presented in the ecological Conceptual Site Model (CSM) provided as **Figure 4**.

In summary, the CSM identifies the slag that has been stockpiled and/or ground and re-distributed over the surface of large portions of the Facility Area as a potential source of COPECs which could subsequently migrate away from the Facility Area via surface water transport to downgradient ecological receptors. Surface run-off from the exposed slag would transport and deposit COPECs into the ephemeral drainage ditches (i.e., East and West Ditches). In addition, portions of the ditches were cut into areas where slag had historically been used as fill; as a result, this slag has become exposed within these ditches and adjacent spoil banks. Certain COPECs are present in elevated concentrations within the slag residuals present in the Facility Area, and are considered the primary smelter-related COPECs; arsenic, cadmium, copper, lead, and zinc.

The drainage ditches serve to collect surface water run-off and convey it to portions of the West Ditch and portions of Rose Creek down-gradient of the Facility Area. These down-gradient sections of the West Ditch and Rose Creek are also ephemeral in nature. They eventually discharge to depositional wetland habitats within the Old Cahokia Watershed located north of the Facility Area, via the West Ditch Outfall and the Rose Creek Outfall, respectively. Further down-gradient from these depositional wetlands lies perennial aquatic habitat; a large expanse of open water near the West Ditch Outfall, and the Engineered Drainage Ditch near the Rose Creek Outfall. Surface waters from the

Watershed eventually discharge to Schoenberger Creek via outfalls located just to the north of Collinsville Road.

COPECs from the source areas within the Facility Area, thus, have the potential to migrate via surface water transport to these down-gradient drainage features, wetlands and aquatic habitats either in a dissolved form or as solids suspended in the water column and re-deposited as sediments.

As discussed previously, the BERA focuses on benthic macroinvertebrates and wetland plants as the receptors of interest (ROI). The ROI are the indicator species selected for evaluation in the BERA. Benthic macroinvertebrates can be exposed to COPECs through direct contact with COPECs in sediment, sediment pore water, and surface water. Wetland plants can be directly exposed to COPECs through uptake from sediment.

3.3 ASSESSMENT AND MEASUREMENT ENDPOINTS

Assessment endpoints, which are defined as explicit expressions of the environmental value that is to be protected (EPA, 1992a), are summarized in Table 3-1. Elevated levels of heavy metals in sediment and surface water are known to be toxic to benthic organisms; thus, preservation of the health and diversity of the benthic macroinvertebrate community is proposed as one of the assessment endpoints for the Site. In addition, COPECs in surface water runoff from the Facility Area discharging into the Old Cahokia Watershed may affect plants; thus, preservation of the health and diversity of the wetland plant community is proposed as the second assessment endpoint for the Site.

A Measurement Endpoint is "a measurable ecological characteristic that is related to the valued characteristic chosen as the assessment endpoint and is a measure of biological effects (e.g., death, reproduction, growth) of particular species, and they can include measures of exposure as well as measures of effects" (EPA, 1997). Measurement endpoints should include risks to, and be representative of, all of the species, populations, or groups included in the assessment endpoint(s) that is/are being investigated in terms of those particular measurement endpoints (**Table 3-1**).

4.0 ECOLOGICAL FIELD INVESTIGATIONS

This section describes the investigative tasks conducted at the Site to provide the data used to develop the BERA. The investigations included the characterization of the aquatic ecosystems present in the Facility Area drainage ditches, Rose Creek, Schoenberger Creek and related wetlands areas in the Old Cahokia Watershed, which are hydraulically connected to the Facility Area, and the collection of biological and chemical data. The data collected included the following:

- Chemical analyses of sediment and surface water from the ephemeral ditches and streams draining the Facility Area, within the Old Cahokia Creek Watershed, and from reference areas;
- Whole sediment toxicity tests of sediment collected from the ephemeral ditches and streams on and downstream of the Facility Area, including the discharge areas in the Old Cahokia Creek Watershed and reference areas;
- Chemical analyses of benthic macroinvertebrate and wetland plant tissues collected from the ephemeral ditches and streams on and downgradient of the Facility Area, including the discharge areas and reference areas;
- Community evaluation of benthic macroinvertebrates collected from the ephemeral ditches and streams on and downgradient of the Facility Area, including the discharge areas and reference areas; and,
- Community evaluation of wetland plants in the discharge areas within the Old Cahokia Creek Watershed and from a reference area within the Watershed.

Samples were taken from locations within drainage ditches, ephemeral streams, and wetlands and from reference sites. Reference sites were selected that as closely as possible mirror the characteristics of the drainage way, stream or wetland being investigated. Due to the ephemeral nature of the surface water features, the goal of sample location selection was to find depositional areas with viable aquatic habitat. The sampling locations and the procedures used to collect the samples are discussed in detail in the SSP and/or the BERA WP and are summarized below.

4.1 SEDIMENT AND SURFACE WATER CHEMISTRY

Sediment and surface water samples were collected from locations detailed in Figure 3 and summarized in Table 4-1 for chemical analysis of COPECs. The methodologies employed for the collection of these samples are presented in Subsection 2.5 of the RI Report. Several of the surface water and/or sediment sample locations are co-located with bioassay and/or biota tissue samples, as described in Subsections 4.2 and 4.3. These co-located data can be used to determine whether any observed toxicity or changes in community structure are related to changes in sediment chemistry.

Prior to collection of surface water and sediments, a YSI Multi-probe meter was utilized to measure various field parameters at each sampling location. The physical parameters measured included: temperature, specific conductivity, dissolved oxygen and reduction-oxidation (redox) potential. Table 4-2 summarizes these field parameter measurements. These data illustrate that during summer months, the surface water locations sampled tended to show very low levels of dissolved oxygen and negative oxidation-reduction potentials (i.e., reducing conditions).

4.2 WHOLE SEDIMENT BIOASSAYS

The potential toxicity of smelter-related COPECs in sediments was tested directly with whole sediment toxicity tests (bioassays). These tests used standard laboratory test organisms to measure the toxicity of the entire mixture of chemicals present in sediments. Sediment bioassays were performed using a 10-day sediment bioasaay with *Chironomus tentans (C. tentans).*

4.2.1 Bioassay Sediment Sample Collection

Bulk sediment samples for the bioassay tests were collected as grab samples from the top 6 inches of sediment (the biologically active zone) following the procedures outlined in the SSP and the BERA Workplan, at a total of seven locations. The locations of these samples are depicted in Figure 3, referenced by the chemistry sample they were co-located with. All bioassay sediment samples were collected from depositional areas where standing water was present. Multiple grab samples were retrieved to obtain enough sediment for the bioassay testing.

The bioassay sample locations are summarized in Table 4-3.

With the exception Sample SD-CT-13, each bioassay sediment sample was co-located with a corresponding sediment chemistry sample, as well as co-located with a benthic macroinvertebrate tissue sample and benthic macroinvertebrate community study location (refer to Subsections 4.3.1 and 4.4.1). Collection of a bioassay sediment and benthic tissue samples was also planned at or near the Rose Creek Outfall. Examination of this area indicated that the only substantial area of standing water was a large isolated pool in the bed of Rose Creek, roughly 200 feet north of Collinsville Road. The sediment chemistry sample SD-13 had previously been collected form Rose Creek immediately north of the Road. It was thus decided to collect the bioassay and tissue samples from this location were surface water was present.

4.2.2 Bioassay Laboratory Methods

A 10-day survival and growth sediment toxicity (biossay) test with the freshwater midge *Chironimus tentans* was performed on the seven sediment samples and a control sediment sample, employing four replicates per sample location. This bioassay followed the methods developed by the American Society for Testing and Materials (ASTM E1706-95b, *Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates*) and the EPA's (2000) *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates.* The bioassay studies were performed by Aquatic Toxicology and Microbiology Laboratory (ATML), University of Michigan, Ann Arbor, Michigan,.

Sediment material was prepared from the collected samples by thoroughly mixing the sediment and removal of large debris that consisted mostly of decaying plant material, and all visible fauna (Table 4-4). The laboratory control sample was prepared from shredded brown paper toweling. At the end of the 10-day study, the sediments were sieved and the surviving organisms were counted. Other indigenous species in the sediment, mostly aquatic worms, were removed but not included in the survival count.

The report prepared by ATML detailing the methods of the bioassay studies is provided as Attachment B.

4.3 TISSUE RESIDUE STUDIES

The quantity of metals in an abiotic media is not always indicative of the toxicity of that media to biota. The fraction of the total metal concentration which is bioavailable is usually a better indicator of toxicity. Factors which can influence the bioavailability of metals in sediments include organic carbon, cation exchange capacity, pH, sulfides, and water hardness. Macroinvertebrate and plant tissue samples were collected following methods presented in the *BERA Workplan.* One field duplicate sample of tissue was collected per every 10 samples. All tissue samples were analyzed for RCRA metals and zinc and moisture content. Tissue samples were collected by Natural Resources Consulting, Inc (NRC) of Cottage Grove, Wisconsin. Tissue samples were collected during the same RI sampling event as the sediment sampling for the bioassays. Attachment C and Attachment D, respectively, provide reports prepared by NRC on the methods and results associated with the macroinvertebrate and plant tissue sample collection.

4.3.1 Macroinvertebrate Tissue

Macroinvertebrate tissue samples were collected from the nine locations illustrated in Figure 3 and summarized in Table 4-5. As described in Subsections 4.1 and 4.2.1, the locations of tissue samples were co-located with sediment samples collected for bioassay purposes and, with the exception of sample SD-13, with the sediment samples collected for chemical analysis

Specifically, an area for tissue sampling/community survey was selected by the field biologist to encompass the associated sediment sampling location; these areas are described in Table 4-6. The selected area was then sampled for benthic macroinvertebrates using D-nets following the procedures described in Region IV EPA guidance documents (2002b), as specified in NRC's report presented in Attachment C. A minimum level of effort of 1 ¼ hour was applied to each sample location, however due to the need to obtain a minimum of 6 to 8 grams of tissue for chemical analyses, the level of effort at a given location was extended to up to 3 hours duration. Also, the initial size of the sample area was occasionally expanded to obtain the requisite sample mass. Specimens were separated from the retrieved matrix of sediment and debris using white pans and forceps; sediments were also sieved in the field to remove smaller specimens. The collected specimens were retained in containers, the samples were enumerated, and each specimen was identified at least to the family level at the conclusion of the collection period. Selected organisms of each taxon were preserved in ethanol and retained for future reference. Aquatic macroinvertebrate species observed to comprise the majority of the community biomass were retained for tissue analysis. The specimens for tissue analysis were rinsed with copious amounts of distilled water placed into labeled plastic bags and stored on ice for shipment to the analytical laboratory under a chain-of-custody form. Typically, the majority if not all of retrieved specimens from a sampling location were included in the tissue sample submitted for analysis, in order to provide the minimum amount of biomass needed for analysis (6 to 8 grams).

4.3.2 Plant Tissue

Vegetation samples for plant tissue analysis were collected at two downstream wetland locations (the West Ditch Outfall and Rose Creek Outfall) and one Reference Area (located at the former Golf Course), as shown on Figure 3. The West Ditch Outfall, Rose Creek Outfall, and the Reference Area were located in the same wetland complex; however, the Reference Area was selected to be hydrologically similar to, but isolated from, the two outfall areas or any other surface influences from the Facility Area.

Plant tissue sampling was performed in concert with the Wetland Plant Community Surveys described in Subsection 4.4.2 below. Tissue sample were retrieved from the same areas assessed by the community surveys. As described below, selected tissue samples at the West Ditch and Rose Creek Outfalls were also generally co-located with sediment samples collected for chemical analyses.

At the West Ditch Outfall, two plant tissue samples were collected. One sample location (PT-SD-31) was immediately downgradient of the stormwater outfall on the south edge of the wetland complex. This location was in the scour channel approximately 30 feet downgradient of sediment chemistry sample SD-31. Sediment chemistry sample SD-45 was also located near PT-SD-31, and may be more representative of the depositional environment downstream of the outfall. The second plant tissue sample was located near the north edge of the wet meadow area located between the outfall and the open water habitat to the northwest. This area was also investigated as part of the vegetation community survey. The sample was held at the laboratory, but not analyzed.

At the Rose Creek Outfall wetland, two plant tissue samples were also collected. One sample location (PT-SD-16) was located at the outfall immediately downstream of Collinsville Road and immediately downstream of sediment location SD-16. This sampling location is in a low terrace immediately adjacent to the scour channel. A second sample was collected at the termini of the Rose Creek channel (this was in the general area of sediment sample TRC-2-S1, collected in July 2007). This sample was held at the laboratory, but not analyzed.

Finally, one plant tissue sample (PT-REF) was collected from the Reference Area location. This location was at a storm drain outfall on the south side of the Collinsville Road between the West Ditch and Rose Creek outfalls.

Tissue samples were collected from herbaceous plants showing visual signs of environmental stress such as chlorosis, malformed leaves, and leaf necrosis. Plants exhibiting signs of stress were noted at both the West Ditch and the Rose Creek Outfalls; however, no attempt was made to quantify the lateral extent of plants exhibiting stress. At the West Ditch Outfall, plants exhibiting chlorosis were specifically noted in and along the edges of the scour channel extending downstream of the outfall (including PT-SD-16), in the survey transect plots in the wet meadow, and near the edge of the wet meadow and the open water habitat, in the vicinity of SD-34. At the Rose Creek Outfall, stress was noted in plants at the belt transect where PT-SD-16 was located, and at the releve plot where plant sample PT-SD-39 was collected. There was no evidence of stress at the reference location.

Approximately 50 to 60 grams of tissue material were collected at each sample location. Each sample consisted of a composite from three to five different herbaceous plant species. The samples consisted of whole plants cut just above the ground level. The collection and sample preparation methods are detailed in NRC's memorandum report presented in Attachment D. After preparation and labeling of sample bags the samples stored on ice and transported under chain-of-custody form to the analytical laboratory.

4.4 COMMUNITY STUDIES

The community studies were performed and the reports prepared by NRC on the methods and results associated with the community assemblage studies are presented in Attachment C and Attachment D, respectively. These studies are summarized below.

4.4.1 Macroinvertebrate Community

A benthic macroinvertebrate community (assemblage) structure and function assessment was performed in the ephemeral creeks and streams hydraulically connected to the Facility Area (East Ditch #1, East Ditch #2, West Ditch #2, Rose Creek, and Schoenberger Creek) and in the Old Cahokia Watershed wetland. Community surveys of benthic macro-invertebrates were conducted at the same nine locations and following the same procedures as outlined in Section 4.3.1 for the collection of macroinvertebrates for tissue analysis. A tenth location, East Ditch # 2 (BT-SD-02), became desiccated before a full sampling effort could be performed. Consequently, only a cursory qualitative taxonomic list could be developed for this location.

4.4.2 Wetland Plant Community

The wetland plant community field survey included measurement of species richness and dominance, percent cover, and a floristic quality assessment (FQA). Vegetation data for the wetland community assessment were collected at the same three sampling locations were tissue samples were collected as described in Subsection 4.3.2. The West Ditch Outfall, Rose Creek Outfall, and the Reference Area sampling areas were located in the same wetland complex; however, the Reference Area was selected to be hydrologically isolated from surface and groundwater influences from the Facility Area. The Reference Area was also selected to have similar hydrologic and topographic characteristics as the West Ditch and Rose Creek outfalls. Specifically, the Reference Area was located immediately down-gradient of an outfall that channels surface water from Collinsville Road to the Watershed. A scour channel was located beneath this outfall; indicating that this Reference Area receives similar physical stress associated with periodic high volume discharges of storm water as the outfall locations.

Wetland vegetation communities were surveyed using procedures described in *Methods for Evaluating Wetland Condition #10 - Using Vegetation to Assess Environmental Conditions in Wetlands* (EPA 2002a) and methods for conducting floristic quality assessments in Illinois (Taft and others 1997; Swink and Wilhelm 1994). The heterogeneous nature of the Old Cahokia Creek wetland complex and unknown disturbance histories of the survey areas precluded establishing sample locations with uniform plant community characteristics. Rather, sample locations with similar hydrologic regimes and similar topographic positions on the landscape within the wetland complex were selected. Depositional environments downstream of the outfalls were selected to represent variations in disturbance regimes between the West Ditch Outfall, Rose Creek Outfall, and Reference Area. As discussed in Section 4.3.2, the sampling locations at the West Ditch Outfall and Rose Creek Outfall survey areas, the sampling locations encompassed areas of obvious disturbance and signs of environmental stress to the dominant vegetation of the plant communities. The sampling areas were selected to represent semi-open to open herbaceous or shrub-scrub wetland community types characteristic of disturbed stormwater outfalls; to provide a conservative assessment the specific material sampled was highly skewed toward organisms showing overt signs of environmental stress.

The vegetation communities were surveyed using a combination of the standard releve (plot-based vegetation sample) and line transect sampling methods as detailed in NRC's memorandum report presented in Attachment D. An inventory of the plant species present within each releve plot was completed and each plant species was assigned appropriate coefficients of conservatism (CC) to each species for purposes of developing the FQAI. Complete descriptions of the vegetation sampling procedures are provided in Attachment D.

5.0 CHARACTERIZATION OF EXPOSURE AND EFFECTS

The extent of potential exposure and effects are characterized in this section. Exposure is the situation where a stressor (e.g., an elevated concentration of a COPECS) is present at the same place and time as, or is in contact with, a plant or animal. Both an exposure-response analysis, which describes the relationship between size, frequency, or duration of exposure to a chemical stressor and the magnitude of the response, and evidence of causality will be used in determining how likely it is that the COPECs found at the Site actually cause the effects on the measurement and assessment endpoints.

5.1 CHARACTERIZATION OF EXPOSURE

The results of the field investigations used to collect data for the BERA are summarized in the following subsections. Where appropriate, these data are compared to preliminary screening values to refine the list of COPECs for the Site; these COPECs are further evaluated in Section 5.2 and Section 6. A detailed description of sediment chemistry at the Site is presented in Subsection 4.3.2.1 if the RI Report and a detail description of the distribution of COPECs within surface water at the Site is presented in Section 4.4 of the RI Report.

5.1.1 Sediment and Surface Water Chemistry

A total of 34 investigative and six field duplicate surface water samples were collected from the drainage features and aquatic habitats at locations illustrated in Figure 3. The results of the chemical analyses of the sediment and surface water samples are presented in Tables 5-1 and Table 5-2, respectively. As many of the surface water samples were collected in drainage features which are ephemeral in nature and represent shallow, isolated and stagnant pools of water. Many of sampling locations have no standing water at other parts of the year.

EPA Region 5 RCRA Corrective Action ecological screening levels (ESLs), available at http://www.epa.gov/Region5/rcraca/edql.htm, were used to initially determine the COPECs in these media. The ESLs are Region 5 media-specific values for RCRA Appendix IX hazardous constituents. ESLs are conservative screening levels with which the surface water and sediments concentrations were compared to help focus the analysis on the chemicals that are most likely to pose an unacceptable risk to the environment. ESLs alone are not intended to serve as cleanup levels.

The drainage features, wetlands, and aquatic habitats which were sampled included ephemeral, intermittent and perennial features. The drainage ditches in the Facility Area, as well as Rose Creek and the West Ditch downgradient of the Facility Area are ephemeral in nature. They do not receive base flow from the underlying shallow aquifer, and only flow in response to precipitation events. Much of the East Ditch #1 and a short section of Rose Creek in the southwest corner of the Facility Area retain some stagnant, standing water throughout the year. This more or less permanently inundated area includes sampling locations SW/SD-1, SW/SD-5, SW/SD-06 and SW/SD-08. The remaining stretches of the ephemeral drainage features both within and downgradient of the Facility Area are typified by dry sections of ditch/creek bed and isolated, stagnant pools.

The Rose Creek and West Ditch outfalls lie at the edge of a terrace that borders the north side of Collinsville Road. These outfalls discharge to wetland habitats that border this terrace slope, and extend into the Watershed Area. These wetlands may be intermittently inundated (i.e., possessing shallow standing water resulting from seasonably high water table). At the West Ditch Outfall area, these bordering wetlands grade abruptly to perennially open water. This open water habitat has bordering wetlands which are also inundated more or less perennially. At the Rose Creek outfall, a large expanse of wetlands exists downgradient of the outfall. This wetland area is also anticipated to be inundated only intermittently if at all. While expanses of perennial open water and mixed open water /emergent wetlands exists to the west of the Engineered Drainage Ditch and in the former golf course area to the east of the Engineered Drainage Ditch, the closest permanent open water downgradient of the Rose Creek outfall is believed to be within the Engineered Drainage Ditch itself. Schoenberger Creek, which receives drainage from the southwestern portion of the Watershed, is a perennial stream.

5.1.1.1 Sediment Chemistry

Arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc exceeded their respective conservative ESL for sediment in at least one sample. Thus, these metals are the COPECs for sediment. The potential for these COPECs to pose a potential risk to aquatic resources is evaluated in this BERA. Several pesticides were also detected in sediment (aldrin, dieldrin, DDE, DDT, endrin, and gamma chlordane) at concentrations above ESLs, but these chemicals are not related to the former smelter operations and are not considered COPECs. The focused sampling for pesticides suggests that their source may be the Cargill facility located along the southeast corner of the Facility Area. The presence of pesticides in sediments from the Cargill facility may contribute locally to stress on the aquatic macroinvertebrate community in the ephemeral drainage features draining the Facility Area.

The primary smelter-related COPCs at the Site are arsenic, cadmium, copper, lead and zinc. With the exception of arsenic, these COPCs show a high degree of correlation in the extent and magnitude of their occurrence. As zinc is a primary COPC at the Site, the correlation between zinc and the other heavy metals found in the sediment was evaluated. A statistical comparison made between the concentrations of zinc and the other metals within the entire sediment data set, including both surface and subsurface samples. Specifically, the value for the Pearson Product Moment Correlation Coefficient [r] was calculated between the dataset of zinc concentrations paired with the concentrations of each of the other heavy metals. The value of r provides a measure of linear correlation between sets of paired data. Values of r can range between -1.0, where the two sets of paired data show perfect negative linear correlation, to +1.0, where the two sets of paired data show perfect positive linear correlation. An r value of 0.0 indicates the two sets of paired data show no correlation. A strong correlation between the relative concentrations of two analytes suggests the two analytes are co-located; i.e., where one analyte is found at a relatively elevated concentration, there is a strong probability that the other one will also be present at a relatively elevated concentration. This relationship in turn suggests a common source for both analytes, as well as a similar pattern of migration. A weaker relationship could suggest differential migration between two analytes that originated from the same source, multiple sources for one or both analytes, and/or one of the two analytes present predominantly at ambient or background concentrations. The correlations are summarized below:

Correlation Between Concentrations of Zinc and Other Metals	
Metal	**Value - r [1]**
Arsenic	0.264454
Barium	0.119209
Cadmium	0.404159
Chromium	-0.07331
Copper	0.775668
Lead	0.656817
Selenium	0.273031
Silver	0.471894
Mercury	0.048625

1 - Pearson Product Moment Correlation Coefficient

The strongest relationship is exhibited between the concentrations of zinc and copper, followed by lead, silver, and cadmium. The weakest relationship with zinc concentrations is demonstrated by chromium, followed by mercury and barium. These weak correlations suggest that the presence of chromium, barium and mercury in sediments is not attributable to the historic smelting operations on the Facility Area.

Other lines of evidence also suggest that historic smelting operations are not responsible for the presence of these chemicals in sediments. For example, the five highest sediment concentrations of chromium were found in Schoenberger Creek, which is not hydraulically connected to the Facility Area with the second highest concentration detected in sample SD-22, located upstream of the outfall from the Old Cahokia Watershed into Schoenberger Creek (refer to Subsection 5.2.3.6). Within Rose Creek, the concentration of chromium in sediments was higher in the reference samples than in samples collected adjacent to and downstream of the Facility Area. Lastly, within the Engineered Drainage Ditch, the concentration of chromium in the surface and deeper samples from location TRC-2-S, which is located down-gradient of the West Ditch Outfall, is similar to that observed in the Engineered Drainage Ditch upstream of the West Ditch Outfall (at sample location 51-Ditch). Further, a similar pattern of increasing chromium concentrations with depth was observed at both locations (TRC-2-S and 51-

Ditch) the source of the chromium at TRC-2-S is not associated with the Rose Creek Outfall.

Like chromium, the concentration and general vertical distribution of barium at sample location TRC-2-S in the Engineered Drainage Ditch was similar to the upstream reference sample SD-51-Ditch, suggesting sources other than the Facility Area are contributing barium to this Ditch. There is a moderate correlation between the occurrence of barium and lead (r = 0.4319), suggesting a possible common source of these metals. For example, lead and barium have been found to be co-located in urban soils impacted by lead-based paints (OMOE, 2002). Barium was also used as an additive in diesel fuel (ATSDR Toxicological Profile for Barium) and the lead and barium could be from runoff from areas affected by the combustion of diesel fuel.

In addition to the weak correlation between concentrations of zinc and mercury in sediments, the mean mercury concentration in samples from the ditches draining the Facility Area (2.28 mg/Kg) is lower than the mean concentration of mercury in samples from Rose Creek up-gradient of the Site (SD-04, and RSD1 through RSD4; an arithmetic mean of 2.75 mg/kg), suggesting historic Facility Area operations are not the source of mercury to sediments in the area. Elevated levels of mercury in sediment samples in the vicinity of the Site may also be attributable to power plant and motor vehicle emissions. There are five coal fired power plants in the greater metropolitan St. Louis area. A U.S. EPA study on motor vehicle mercury emissions provided evidence of a mobile source contribution of environmental mercury (U.S. EPA 2004).

Thus, the sediment data strongly suggest that barium, chromium, and mercury are not present within sediments of drainage ways and aquatic habitats downstream of the Facility Area as a result of historic smelting operations. Even so, to be conservative, these three metals were not eliminated from the list of COPECs for the BERA, and are evaluated herein.

5.1.1.2 Surface water Chemistry

Total and/or dissolved concentrations of barium, cadmium, chromium, lead, mercury, selenium, silver, and zinc exceeded the conservative screening level ESLs for surface water in at least one sample (Table 4-1). Consequently, these metals are selected as the COPECs for surface water. Note however, that the comparison to ESLs to select COPECs is very conservative because it does take into account the nature of the source of the source of the surface water (i.e, that many of surface waters sampled in the vicinity of the Site are ephemeral). A comparison of dissolved COPEC concentrations detected in perennial surface water features (specifically, the open water habitats and Engineered Drainage Ditch within the Cahokia Creek Watershed, and Schoenberger Creek) to Illinois General Use Surface Water standards reveals no exceedence of these standards. These standards are not applicable to waters contained within the ephemeral drainage features at the Site.

5.1.2 Bioassays

The results of the whole sediment bioassay are summarized in Table 5-3, which also presents a description of the test sediments. The complete bioassay report is provided in Attachment B. Although the laboratory negative control survival was 87.5%, which meets the test requirement of having at least 70% survival in the control and indicates the results of the bioassay are valid, all seven test samples, including the upstream reference sample, had effectively 100 percent mortality. No test organisms (i.e., midges) survived in five of seven tested samples and only a single midge survived in the other two tested sediment samples. However, some indigenous species, mostly aquatic worms, were found in the test sediments at the start and at the end of the study period.

These findings suggest that the results of the whole sediment bioassay are not likely to provide important information about the potential toxicity of COPECs in sediments to benthic macroinvertebrates for several reasons.

- No pattern of mortality with respect to location was observed. Test organism mortality was consistently high regardless of their location on, or relative to, the Site. If Site-related COPECs were solely responsible for the observed mortality, greater survival would have been expected in reference locations or more downstream, less potentially affected locations. Such a pattern was not observed.

- No pattern of mortality with respect to COPEC concentrations was observed. As with location, if Site-related COPECs were primarily responsible for the mortality of test organisms, mortality would be expected to vary with varying COPEC concentration; low mortality would be expected at locations with low COPEC concentrations and high mortality at locations with elevated COPEC concentrations. Such a dose-response relationship was not observed. Test organism mortality was high over zinc concentrations ranging from 750 mg/kg to 35,000 mg/kg; lead concentrations ranging from 70 mg/kg to 3300 mg/kg; and cadmium concentrations ranging from 19 mg/kg to 460 mg/kg. The absence of any pattern of mortality with varying COPEC concentrations may be indicative of the presence of some other, more important stressor in the sediments (or an issue with the test conditions).

- Nearly all of the mortality of test organisms occurred within the first 24 hours of the test. This suggests some characteristic of the test conditions may have severely affected the test organisms. One observation suggesting that some characteristic of the test conditions (and not the tested sediments) may be the cause of the observed mortality is that native organisms contained in the sampled sediment were noted to still be alive at the termination of the test. Of course, it could also be that the native organisms have developed a tolerance to the characteristic of the sediments responsible for the observed toxicity.

- Another line of evidence suggesting test conditions and not COPEC concentrations are responsible for the observed mortality of test organisms is the change in several regularly monitored test parameters. Standard test protocols recommend that the hardness, pH, alkalinity, and ammonia in the overlying water within the treatments should not vary by more than 50% over the test duration. However, significant variability between startup and final concentrations was recorded for ammonia, which decreased by up to 426% in all the overlying water samples for the respective sediment over time, with the exception of SD-13, where it increased by a factor of three. The startup and end ammonia concentrations were higher in the test sediments (1.0 to 5.8 mg/L) than in the lab control (0.72 mg/L), except for the Day 0 ammonia concentration was lower at SD-13 (0.42 mg/L). Thus, conditions in the test vessels, not related to COPEC concentrations, could be responsible for the observed mortality.

While the presence of COPECs in sediments cannot be ruled out as a contributing factor to the mortality of test organisms in the sediment bioassay, the above observations suggest that some other factor associated with either the sediments or with the test conditions had a greater effect on the survival of the test organisms. This is an important observation because it means that the whole sediment bioassay results cannot be used as a line of evidence to determine whether the COPECs are adversely affecting the aquatic environment. Fortunately, two other Site-specific lines of evidence are available. One is the comparison of measured macroinvertebrate tissue concentrations to allowable tissue concentrations. The second is the benthic macroinvertebrate community evaluation. Each of these is described below. Further interpretation of the results of the bioassay test is presented in Subsection 6.1.2.

5.1.3 Tissue Residue Studies

The results of the chemical analyses of benthic and plant tissue are provided in Table 5-4 and Table 5-5, respectively.

5.1.3.1 Macroinvertebrates

Arsenic, barium, cadmium, chromium, lead, mercury, selenium, and zinc were detected in benthic tissue samples. Mercury was only detected at the control location, BT-SD-001. These metals were also detected in co-located sediment chemistry samples. To evaluate the bioavailablity of metals in sediments to benthic macroinvertebrates, regression analyses were performed comparing the primary COPECs (i.e., cadmium, lead and zinc) in benthic invertebrate tissue to metals in co-located sediment. A positive and statistically significant regression coefficient is an indicator that the concentration of metals in tissue is related to the concentration of metals in sediment, i.e., that metals in sediment are bioavailable to macroinvertebrates. The regressions for cadmium, lead and zinc were highly significant (i.e, R^2 = 0.8066; p-value = 0.00042 for cadmium; R^2 = 0.6149; p-value = 0.00725 for lead; R^2 = 0.759; p-value = 0.00121 for zinc, Figure 5,) suggesting these metals are bioavailable. However, they are substantially less bioavailable than reported at other sites. The slope of the regression line (which is equivalent to the biota sediment accumulation factor (BSAF)) is 0.00393 for cadmium, 0.00121 for lead, and 0.00355 for zinc. This means that macroinvertebrate tissue concentrations are about 250, 800 and 280 times lower than sediment concentrations of cadmium, lead and zinc, respectively. The Site-specific BSAFs are about 10, 65 and 235 times lower than median BSAFs reported in the literature for cadmium (median BSAF of 0.0459), lead (median BSAF of 0.08) and zinc (median BSAF of 0.84), respectively (BJC, 1998).

5.1.3.1 Wetland Plants

Barium, cadmium, chromium, lead, selenium and zinc were detected in plant tissue. These metals were also detected in co-located sediment samples, except selenium was not detected in SD-16. Arsenic, mercury, and silver were not detected in plant tissue though they were detected in sediment. The concentrations of cadmium, lead, selenium, and zinc were elevated in relation to the reference tissue sample.

The concentrations of metals in plant tissue were lower than corresponding sediment concentrations (except for cadmium at SD-16, Table 5-5). Though regression analyses was not performed for plants due to the limited number of samples (two investigative and one reference), simple comparison of the range of metals concentrations in sediment locations where plant tissue was also collected provides some information about bioavailability of metals to plants and the affect of metals in sediments on the metals concentration in plants. It appears that concentrations of barium, cadmium and lead in plants are independent of sediment concentration because plant tissue concentrations remain about the same even though sediment concentrations varied substantially. The concentration of zinc in plants appears to be affected by the concentration of zinc in sediments. The affect of the concentrations of arsenic, chromium, mercury, selenium and silver in sediment on their respective plant tissue concentrations could not be determined because sediment and tissue concentrations were about the same at the two sampling locations with co-located sediment and tissue data. Given the limited number of co-located plant tissue and sediment samples, these observations need to be viewed as preliminary. Further, the plant tissue sampling effort was highly skewed towards plant specimens exhibiting overt signs of stress, which included chlorosis, malformed leaves, and leaf necrosis and it is unclear whether these findings would apply to plants in areas without obvious signs of stress. Nevertheless, the available data suggest that of the smelter-related heavy metals, only zinc is bioavailable to plants and that cadmium and lead may not be.

5.1.4 Community Studies

The ecological investigation included collection of aquatic macroinvertebrates and wetland plants for analysis of community health. The complete macroinvertebrate and plant community study reports are provided in Attachment C and D.

5.1.4.1 *Macroinvertebrates*

Several variables in combination are effective in characterizing benthic community structure (EPA, 1992b): numbers of taxa, numerical dominance, total abundance, ad percentage composition of major taxonomic groups (e.g., oligochaetes, chironomids, and other major insect groups). Aquatic macroinvertebrates for community assessment analysis were generally identified to the family level in the field. Thirty taxa were identified for the area waterways (Table 5-6). Fourteen of the 30 identified families have species that are air breathers, and thus provide limited information for a biological assessment of the aquatic macro-invertebrate communities. The lowest number of organisms and number of taxa were found at sampling location SD-34, which is at the edge of the open water habitat downstream from the West Ditch #1 outfall. The highest number of organisms and number of taxa were found in the sample locations in Schoenberger Creek (SD-22, SD-36, and SD-37). The lowest MBI and TBI indices were found in Rose Creek, downstream of the Facility Area at location SD-13. A lower index indicates less organic pollution. The indices at SD-13 was 6, which represents fair water quality, while the indices for the sample collected from Rose Creek at the East Ditch #1 discharge ranged from 6.94 to 7.29 indicating fairly poor water quality. Schoenberger Creek also had fairly poor water quality (TBI = 6.9-7.0, Table 5-6) even it has not hydrological connection to the ditches on the Facility Area and had the highest number of organisms and taxa.

5.1.4.2 *Wetland Plant Community*

The heterogeneous nature of the Old Cahokia Creek wetland complex and unknown disturbance histories of the survey areas precluded establishing sample locations with uniform plant community characteristics. The sampling areas were selected to represent semi-open to open herbaceous or shrub-scrub wetland community types characteristic of disturbed stormwater outfalls. The wetland plant community field surveys focused on measurement of species richness and dominance, and percent cover. Samples were taken from discharge locations within the wetland complex and from a reference site within the wetland complex to evaluate the potential for adverse effects. The highest total number of species was found in Plot #2 from the Rose Creek outfall sample location, though the highest number of native species was found in Plot #2 from the Reference area sample location. In general, all of the plant communities surveyed were dominated by disturbance tolerant or ruderal (weedy and adventive) species characteristic of highly altered natural environments.

5.2 CHARACTERIZATION OF EFFECTS

Often several lines of evidence are needed to evaluate whether chemicals from a site are potentially affecting the assessment endpoint(s). The *BERA Work Plan* identified a triad approach (i.e., sediment/surface water chemistry, bioassay testing, and community surveys and tissue sampling) for assessing the potential for adverse ecological effects on the aquatic habitats at the Site. The following subsections provide an assessment of potential exposure to the aquatic habitats, following the three elements of the triad approach.

5.2.1 Sediment and Surface Water Chemistry

One line of evidence used to assess potential impacts to transient aquatic receptors is the comparison of chemical data to sediment and surface water screening criteria. Note that the sediment and surface water screening criteria described herein were developed for sediments lying below surface water the majority of the time where the surface water is capable or should be capable of providing for an aquatic biota habitat. The drainage ditches within the Facility Area and Rose Creek and Rose Creek outfall are ephemeral, channelized drainage features. The West Ditch outfall drains to a small wet meadow and marshland area located north of Collinsville Road. The Rose Creek Outfall drains to a scour channel that drains to a wetlands area located south of the historic location of the Engineered Drainage Ditch. All of the surface water features investigated as part of this BERA have been physically altered and provide limited aquatic habitat. Thus, comparison of chemical concentrations in Facility Area drainage features to sediment and surface water screening criteria, which are applicable to true surface waters rather than ephemeral drainage features, is a conservative evaluation of potential aquatic life impacts within the Facility Area drainage features and downstream surface waters. The main purpose of the comparison to screening criteria is to provide an understanding of the spatial extent and concentration trends of smelter-related COPECs within the aquatic features on and downgradient of the Facility Area.

5.2.1.1 Sediment

Mean probable effect concentration quotients (PEC-Q) provide a means by which the potential toxicity of mixtures of chemicals present in sediments can be compared between sample locations within a given area or a site. Mean PEC-Q were calculated for each sample location to identify segments of the Facility Area ditches and hydraulically connected water bodies that have higher versus lower overall metals concentrations, which would also suggest a higher or lower potential for aquatic toxicity.

Consensus-based sediment quality guidelines (SQGs) (MacDonald et al. 2000a) represent the geometric mean of published SQGs from a variety of sources. These SQGs are called Probable Effect Concentrations (PECs) and threshold effect concentrations (TECs). TECs are intended to identify chemical concentrations below which harmful effects on sediment-dwelling organisms are not expected. Given the conservative nature of the derivation of TECs, in most situations, no toxicity is observed when concentrations of a chemical are below its respective TEC. PECs are intended to identify chemical concentrations above which harmful effects on sediment-dwelling organisms are expected to occur more often than not. However, practical application of PECs has found that exceedence of a PEC by one or more chemicals does not mean a sediment will pose potential toxicity in many situations. The lack of toxicity when a PEC is exceeded may occur for many reasons, including the presence of confounding chemicals in the derivation of SQGs used to establish the PECs and the use of spiked sediments to estimate toxicity of a chemical rather than testing natural sediment in which bioavailability of a chemical may be greatly reduced, as appears to be the case at this Site.

Mean PEC-Qs for metals at this Site were estimated using methods adopted from Ingersoll et al. (2000, 2001). In the case of metals, a mean PEC-Q is calculated by summing the PEC-Q for the individual metals and dividing by the total number of metals. Mercury is not included in the PEC-Q metals calculations (Ingersoll et al. (2000). Ingersoll et al. (2000) observed an overall increase in the incidence of toxicity with an increase in the mean quotients in toxicity tests, and that there is a consistent increase in the toxicity at a mean quotient of > 0.5. For the 10-day *Chironomus tentans* test, there was a 20% incidence of toxicity at mean quotients of <0.1 increasing to a 64% incidence of toxicity at mean quotients of >5.0 (Ingersoll et al, 2000). The finding of only 64% incidence of toxicity in sediment with PEC-Qs exceeding 5 is indicative of the conservative nature of the SQGs used to derive the consensus-based PECs and why mean PEC-Q of greater than 1.0 does not mean that toxicity in such sediments is more probable than not.

The greatest value of PEC-Qs is to provide a common basis for comparing the potential for different water bodies at a particular site to pose a potential risk to benthic macroinvertebrates. Sediment with higher mean PEC-Qs would be expected to have a greater potential to pose a risk to benthic macroinvertebrates than sediments with a lower mean PEC-Q. The trends in PEC-Qs in the Facility Area drainage features and hydraulically connected water bodies are discussed in Section 6.1.1.

5.2.1.2 Surface Water

Evaluation of surface water chemistry is performed by comparing dissolved chemical concentrations in surface water to acute and chronic general use water quality standards for protection of aquatic organisms developed by IEPA and presented in Subpart B, 35 Illinois Administrative Code (IAC) Part 302.208. Many of the surface water samples were collected in drainage features which are ephemeral in nature, including the Facility Area ditches, Rose Creek and the Rose Creek Outfall. Surface water samples from these areas were collected from very shallow, isolated and stagnant pools of water, many of which were found to hold no standing water at other parts of the year. Due to their ephemeral natures, COPEC concentrations in water within the Facility Area ditches and Rose Creek are not relevant to these standards. However, all surface water data collected from the Site was compared to these standards to provide a conservative evaluation of potential risks to aquatic life and to provide an understanding of the spatial extent and concentration trends of smelter-related COPECs within the aquatic features on and downgradient of the Facility Area.

For the metals that have water quality based standards dependent upon hardness, the chronic water quality standard was calculated using the hardness of the water body at the time the metals sample was collected. Comparison to the acute standard (AS) values is most applicable to single grab sample results. The acute and chronic aquatic life standards in 35 IAC 302.208(f) are identical to data presented by USEPA within the National Recommended Water Quality Criteria: 2002 document (USEPA, 2002) for protection of aquatic life.

The trends in surface water quality criteria exceedances, which in turn would suggest a lower or higher potential for aquatic life impacts in the Facility Area drainages and hydraulically connected water bodies are discussed in Section 6.1.1.

5.2.2 Bioassays

Whole sediment toxicity tests (or bioassays) are used to directly evaluate the bioavailability and toxicity of chemicals and other stressors in sediment to selected test organisms (EPA, 1997). Benthic organisms were exposed to Site sediment in order to evaluate the effects of the sediment on the survival and growth of these organisms. As described in EPA (2000), the performance of bioassay test organisms in the negative (laboratory) control is used to judge the acceptability of the bioassay, and a reference sediment is used to evaluate performance of the organisms in the investigative sediments. Testing of a reference sediment provides a site-specific basis for evaluating toxicity. If survival and/or growth in site sediments are significantly different from the reference sediment, then the site sediments are general considered to have the potential to pose toxicity to benthic macroinvertebrates. Testing of the negative control is used as a measure of test acceptability, evidence of test organism health, and a basis for interpreting data obtained from the test sediments. If the organisms in the negative control do not meet performance criteria (i.e., having at least 70% survival in the control), the results of the investigative sediments are considered questionable because it suggests that the test organisms may not have been healthy or that some aspect of the test conditions in the laboratory was faulty. If survival is low in the reference sediments, that often indicates that some stressor other than the stressor being investigate at a site may be present in native sediments and be responsible for any observed mortality in test sediments.

For the whole sediment bioassays described herein, one of the field samples, CT-SD-01, was originally designated as a reference location, and is identified as such in the test report. Sediment chemistry from this location suggests that even though this sample was collected from upstream of the Facility Area, it contains elevated concentrations of some COPECs. If the COPECs present in the sample are not related to the Site, then the reference sediments are representative of background conditions and are appropriate to use as a reference.

The results of the benthic bioassays are summarized in Table 5-3, which also presents a description of the test sediments. The results of the bioassay evaluation, including a discussion on the potential for adverse effects on benthic organisms, are provided in Section 6.1.2.

5.2.3 Tissue Studies

The ecological investigation included collection of aquatic macroinvertebrates and wetland plants for analysis of body burdens of specific heavy metals. The presence of COPECs in tissue may be evidence of exposure to bioavailable Site-related COPECs in sediments. However, it may also simply be evidence of exposure to background concentrations of metals. Moreover, the mere detection of COPECs in tissue does not indicate that a risk is present. To evaluate whether tissue concentrations have the potential to pose a risk, tissue concentrations are compared to tissue effects concentrations available in the literature. Sources of tissue residue effect data include:

- U.S. Army Corps of Engineers/U.S. Environmental Protection Agency Environmental Residue-Effects Database (ERED). http://el.erdc.usace.army.mil/ered/
- *Trace Elements in Soils and Plants.* Kabata-Pendias and Pendias (1992).

The ERED database is a compilation of data, taken from the literature, where biological effects (e.g., reduced survival, growth, etc.) and tissue chemical concentrations were simultaneously measured in the same organism. The database contains information on a broad range of biological effects caused by the presence of a particular chemical in the tissue of an organism, from the induction of particular enzymes or enzyme systems to whole-organism effects on survival, growth, or reproduction. Currently, the database is limited to those instances where biological effects observed in an organism are linked to a specific chemical within its tissues. The ERED database was searched for COPEC effects on benthic invertebrates, focusing on whole body residues for juveniles and adults. Both no effect and effect residue values were selected from the ERED database based on the similarity of the test species and the target species (i.e., benthic macroinvertebrates) and based on the endpoints of survival, mortality, growth or reproduction. The no effect residue value is the highest no observable effect concentration (NOED) (but not exceeding an effect dose) and the effect residue value is the lowest observable effect concentration dose (LOED) or the effective dose to 20% or less of the test species (ED-20). The database search results for benthic organisms are summarized in Table 6-3. The complete database search results are provided in Attachment E.

For plants, only about ten trace elements are known to be essential for all plants. Ranges of trace element concentrations and classification of their concentrations in mature leaf tissue were obtained from Kabata-Pendias and Pendias (1992). Classifications include deficient, sufficient or normal, excessive or toxic, and tolerable in agronomic crops. Plant tissue data collected at the Site were compared to these tissue concentration ranges (Table 5-5).

The results of the tissue comparison, including a discussion of the potential for adverse effects on benthic organisms and plants, are provided in Section 6.1.3.

5.2.4 Community Studies

Population/community evaluations, or biological field surveys, are the most direct and Site-specific way of evaluating the potential for adverse ecological effects because they are based on the organisms present at a site and are integrate all potential pathways of exposure (direct contact and ingestion of food, where applicable) and account for any factors that may mitigate or enhance the potential toxicity of the chemicals being investigated. Given the importance and relevance of community studies, both the benthic macroinvertebrate and plant communities in the vicinity of the Site were evaluated.

5.2.4.1 Macroinvertebrates

The benthic macroinvertebrate family-level data collected from the Site provide a direct measure of the health of the benthic communities at the investigated locations. The taxa lists were developed based on qualitative sampling, with a frequency of occurrence estimated for the sampled taxa at the time of collection. This information is appropriate for developing semi-quantitative assessments of the benthic communities. Note that the lack of flow and ephemeral nature of the waterways in the Site area restricts the benthic community evaluation to one only those portions of the Facility Area ditches and surrounding waterways where water was present. The evaluation of the indices calculated for this Site in relation to indices for other aquatic habitats provides a conservative evaluation of potential aquatic life risks.

NRC developed Macroinvertebrate Biotic Index (MBI) values for the sampled locations associated with the Facility Area using a system similar to that used by IEPA. IEPA uses an MBI metric as a measure of organic, oxygen-depriving pollution in stream environments. The IEPA has used the MBI for stream assessments since 1983 (*Water Monitoring Strategy 2002-2006*, August 2002). In utilizing an MBI, the IEPA applies the Hilsenhoff Biotic Index (HBI, Hilsenhoff, 1982, 1987, 1988) which has been refined for use on the taxonomic family level. This procedure, developed by Hilsenhoff (1982, 1988) for Wisconsin streams, is a semi-quantitative assessment of organic, oxygen-depleting pollution of flowing waters. The HBI system assigns a tolerance value (of low oxygen and high organic waste levels) to aquatic arthropod species found in flowing waters. A higher HBI value, on a scale of 0 to 10, indicates a higher tolerance of low dissolved oxygen and high organic pollution conditions.

Implementing the HBI system initially required counting organisms to a 100-count, a semi-quantitative analysis. The HBI count has since been modified to count a maximum of ten organisms of each encountered taxon. This approach limits bias due to dominance effects of one or two species in a sample (Hilsenhoff, 1998). Using the maximum ten-count per taxon, NRC developed MBI values for all of the benthic sampling locations associated with the Site, including East Ditch # 2, which is based on a very limited sampling effort as the location became desiccated before a full sampling effort could be performed (Table 5-7). The MBI was the only semi-quantitative metric developed for the benthic community analysis. The MBI values developed for the Site can be used to compare the sampling locations with each other, but their use is somewhat limited in that the MBI was developed as a measure of benthic community response to oxygen-depleting organic wastes (e.g., high biochemical oxygen demand materials) in flowing waters. Table 5-7 also shows the results of applying the MBI tolerance values for aquatic macroinvertebrate families based solely on organism presence. This approach is a qualitative assessment, resulting in Tolerance Biotic Index (TBI) values, used by the Wisconsin Department of Natural Resources (Lillie and Schlesser, 1994). The TBI is the average tolerance value for the taxa-assigned tolerance values in a sample. The MBI (IEPA, 2002) and TBI (Lillie and Schlesser, 1994) are calculated as follows:

$$MBI = \sum n_i t_i)/N$$

Where:
ni = number of individuals in each listed taxo
Ti = tolerance rating for each listed taxon
N = total number of listed organisms counted

$$TBI = =\sum t_i/T$$

Where:
Ti = tolerance value for each listed taxon
T = number of listed taxa in the sample

Other qualitative metrics were also applied to the benthic community data including taxa richness (number of identified taxa in a sample), Community Similarity Index, Jaccard's Coefficient of Community, and Community Loss Index (CLI). The Community Similarity (S) Index (EPA 1990) is used to determine whether shifts in community assemblages have occurred along a stream gradient or above and below a potential source of a stressor. It is expressed as a percentage. The higher the percentage Index of Similarity value, the greater the similarity between the benthic community at the reference site and the study site. The Jaccard Coefficient of Community (EPA 1990) measures the degree of similarity in taxonomic composition between two stations in terms of taxa presence or absence and discriminates between highly similar collections. Coefficient values, ranging from 0 to 1.0, increase as the degree of similarity with the reference station increases. The CLI is a measure of the differences of taxa occurring in the benthic communities in a waterway from a reference condition, typically an upstream location. A CLI value of zero indicates no loss of taxa in the downstream benthic community compared to that of the reference location. The upper end of the CLI range is open-ended (infinity), indicating complete loss of common taxa between the sampled benthic community and the reference community. These coefficients are calculated as follows:

$$\text{Jaccard's Coefficient} = C / A+B-C$$
$$\text{Community Similarity Index (S)} = 2C/(A+B)$$
$$\text{CLI} = (A-C)/B$$

Where:

A = number of taxa in sample 1 or reference station.
B = number of taxa in sample 2 or comparison station
C = number of taxa common to both samples

The community assessment indices and equations are presented in Table 5-6 and Table 5-7 and in Attachment C. A discussion on the potential for adverse effects on the benthic community, based on these indices, is provided in Section 6.1.4.2.

5.2.4.2 Wetland Plant Community Study

The Floristic Quality Assessment Index (FQAI) is a vegetative community index based on the method developed for the Chicago region by Wilhelm and Ladd (1988). This index is capable of measuring ecosystem condition because it assigns a repeatable and quantitative value to vegetation community composition (EPA, 2002a). Two NRC scientists completed an inventory of the plant species present within each releve plot and assigned appropriate coefficient of conservatism (CC) to each species for purposes of developing the FQAI. Individual CC values were taken from Taft and others (1997), which provide values that more adequately reflect species characteristics outside the Chicago Region. The density and percent cover for each dominant species was also recorded for each releve plot. For woody and some larger herbaceous species, these measurements were taken directly from the 100 m^2 plots. However, to develop estimates for smaller or more abundant herbaceous plants (e.g., *Amarathus retroflexus*), one or more 1m x 1m nested quadrats were sampled in "average" conditions within each releve.

A FQAI for each sample location was developed using the formula:

$$\text{Native Floristic Quality Index (FQI)} = \text{Mean C}(\sqrt{N})$$

Where:

Mean C	=	ΣCoefficients of CC/N
CC	=	coefficients of conservatism for individual species
N	=	native species richness.

Total mean C and a total FQI score was also developed for each sample location using total species richness (native plus non-native species), where non-native species were assigned CC values of zero. Theses measure often better reflects the actual integrity of a site than simply using native species for the FQAI analysis (Taft and others 2006). The native species richness for each community was also calculated by dividing the number of native species by the total number species within each sample (Table 5-8 and Attachment D). In general, sites with an FQI value greater than 35 are at least regionally noteworthy natural areas. If the mean C is 3.5 or higher and/or the FQI registers in the middle thirties or higher, it is relatively certain that there is significant native character at a site to be important in terms of a regional natural area perspective.

The field survey data was used to develop a FQAI for each sample location. This community assessment index is used to evaluate the results of the plant community study; a discussion on the potential for adverse effects on the wetland plant community is provided in Section 6.1.4.2.

6.0 RISK CHARACTERIZATION

Risk characterization (Step 7) is the final step of the BERA process and includes two major components: risk estimation and risk description. Risk characterization combines the results of the studies performed to produce an estimate of the potential ecological risk and describe that potential risk in terms of extent, whether potential risk is expected to change in the future, how long might elevated concentrations of COPECs are likely to remain, and whether natural recovery is likely to occur if no action is taken.

6.1 RISK ESTIMATION

The risk estimation section describes how the lines of evidence that comprise the sediment Triad approach (i.e., sediment chemistry, whole sediment toxicity test/benthic invertebrate tissue measurement, community survey) are integrated to draw conclusions about potential risk. The lines of evidence used in this BERA to characterize potential risk to aquatic biota:

- Comparing measured COPEC concentrations in sediment and surface water to generic (not Site-specific) and conservative screening levels;
- Comparing results of whole sediment toxicity tests of Site sediments to reference sediments;
- Comparing COPEC concentrations in benthic macroinvertebrate tissue to COPEC concentrations in tissues from a reference location and to tissue concentrations and to allowable tissue benchmarks derived from the literature; and,
- Comparing the benthic invertebrate and wetland plant communities potentially affected by Site-related COPECs to benthic invertebrate and wetland plant communities at an unaffected reference location.

6.1.1 Sediment and Surface Water Chemistry

Sediment

The sediment chemistry data at each sample location has been assessed through the use of the mean PEC-Q, which is a conservative measure of the potential for COPECs in sediment to pose a risk to benthic macroinvertebrates (Table 6-1; Attachment F). The trends in PEC-Qs, which in turn would suggest a lower or higher potential for benthic community impacts in the Facility Area drainage features and hydraulically connected water bodies, are discussed in this subsection. As previously discussed, the mean PEC-Q is best used to evaluate the relative potential of sediments in different portions of the Site water bodies to pose a potential risk. Comparisons of mean PEC-Qs from different sample locations from the same site allows for an assessment in overall changes or trends in potential sediment toxicity. As discussed above, mean PEC-Qs cannot be used to determine whether a particular sediment is toxic or not, s described by MacDonald *et al.* 2000a and Ingersoll *et al.* (2000). Evidence of PEC-Qs not being predictive is the finding of several reference sediment samples with PEC-Qs that would suggest 100 percent mortality of the macroinvertebrate fauna even though direct observation of these locations indicates the presence of viable populations of macroinvertebrates.

The mean PEC-Q for the drainage ditches within the Facility Area range from 2.6 in East Ditch #2 (SD-02) to 72.4 in West Ditch #1 (SD-25) (Table 6-1; Figure 6). The highest mean PEC-Q within Rose Creek was adjacent to the Facility Area at SD-08 (32.2) and the lowest mean PEC-Q was downstream of the Facility Area at SD-12 (2.4). The primary COPECs contributing to the elevated mean PEC-Q were cadmium, lead and zinc. Silver and mercury are not included in the mean PEC-Q, though concentrations of these metals had high individual PEC-Q at several drainage ditch locations.

Upstream of the Facility Area, the mean PEC-Q in Rose Creek ranged from 1.3 to 4.1, with cadmium, lead, zinc and mercury having high individual PEC-Q in several upstream samples suggesting that the area-wide concentration of several COPECs is elevated due to numerous sources and the Facility Area is not the only contributor.

At the Rose Creek Outfall, mean PEC-Q values ranged from 0.24 at SD-16 to 52.2 at TRC2-S. Transect sample TRC2-S was collected within the engineered drainage system downstream of the outfall; however, elevated mean PEC-Q values (4.97 – 13.86) were also calculated for the upstream sample (SD-51) within this engineered drainage system. Arsenic, cadmium, copper, lead, mercury, silver, and zinc had high individual PEC-Q at all sampling depths (0-6", 8-10", 12-14") at TRC2-S, with the highest mean PEC-Q at the intermediate depth interval. These same COPECs had high individual PEC-Q in the upstream sample (SD-51) within the engineered drainage system, suggesting that another source is contributing to the contamination within this system. Sample TRC2-S1, collected downstream of the outfall before reaching the engineered drainage system, had a mean PEC-Q of 15.2, which is comparable to the PEC-Q values in the engineered drainage system upstream sample (SD-51). Cadmium, lead, silver, and zinc had high individual PEC-Q in transect sample TRC-S1; just as high individual PEC-Q were found for these metals in upstream sample SD-51.

Remaining samples collected within the Rose Creek outfall area (SD-14 through SD-18) had a maximum mean PEC-Q of 1.8. This value is similar to the PEC-Q values for other watershed reference sample (e.g., SD-50 in Old Cahokia Creek, and transect sample TRC-3-S). Reference samples for this area had mean PEC-Q ranging from 1.2 to 3.0, with cadmium and zinc as the primary contaminants. The Rose Creek outfall is also ephemeral, though it drains into the larger Old Cahokia wetland complex.

Many of the transect samples in the western portion of the Old Cahokia Watershed of the wetland complex were collected within open water features. A review of historic aerial photographs shows that the water bodies are borrow pits, probably dug to provide cover for the landfill. Samples collected within the impoundments had low mean PEC-Q (0.03 to 0.83). These samples are not considered to be representative of background levels within the wetland complex because the areas were excavated. The bottom sediments in the impoundments would be characteristic of deeper soils within this area. Furthermore, they tend to be more hydraulically isolated from other surface water drainage features and associated wetlands, and thus not as prone to influences from other sources of heavy metals within the vicinity of the Site.

At the West Ditch Outfall, the mean PEC-Q ranged from 0.64 at SD-33 to 34.9 at SD-34. Cadmium and zinc had the highest individual PEC-Q while lead and copper also had elevated individual PEC-Q in several samples from the West Ditch outfall area. Of note, the arsenic concentrations in the West Ditch Outfall samples ranged from 4.6 mg/kg to 25 mg/kg, which is similar to the State of Illinois (35 IAC Part 742) background concentration for arsenic in soil (13 mg/kg) and is considerably less than the arsenic concentrations (8.5 to 130 mg/kg) measured in the drainage ditches on the Facility Area. Other sources of heavy metals have impacted the wetland complex around the West Ditch Outfall, including illegal dumping, automobile emissions, roadway runoff, coal-fired power plants, and spent shot from waterfowl hunting. Reference samples were collected throughout the wetland complex, from areas considered to be upgradient or a considerable distance from the outfall so as to not be hydraulically impacted by the outfall. The general flow of water through this wetlands complex is from the northeast to the southwest. The locations considered to represent background include transect samples upgradient (north) of the outfall (TWD-1N, -1S, and -1C), transect locations on the opposite side of the open water from the outfall area (TWD-2N), and the transect sample south of the outfall but not hydraulically impacted by the outfall (TWD-3S, -3C, 3N). The mean PEC-Q values from the background locations ranged from 0.42 to 5.4, with cadmium, lead, and zinc being the primary metals contributing to the PEC-Q. The sample location (TWD1-S) with the highest mean PEC-Q was located upgradient (north) of the outfall. Thus, locations with PEC-Q up to 5.4 may be representative of ambient conditions within the wetland complex in the vicinity of the West Ditch outfall. The ten locations within the area that exceeded this PEC-Q were in close proximity of the West Ditch Outfall drainage swale and include SD-34, SD-38, SD-40, SD-32, SD-45, SD-46, SD-47, SD-48, and TWD-02-C-06, and TWD-02-S-06 (Table 6-1).

Within Schoenberger Creek, the mean PEC-Q ranged from 0.63 at SD-36 to 2.1 at SD-52. The mean PEC-Q in the sample collected south of Collinsville Road (SD-22) was 1.3, which is higher than the mean PEC-Q for the samples collected near where the engineered drainage system discharges to the creek. The highest mean PEC-Q in Schoenberger Creek was measured furthest downstream at a location downgradient of the west boundary of the Old Cahokia Watershed, within the channelized and bermed Schoenberger Creek. The COPECs with individual PEC-Q values greater than 0.5 were chromium, lead, and zinc. The highest individual PEC-Q for chromium was 0.63 in the samples from the Facility Area drainage ditches, while the individual PEC-Q for chromium in Schoenberger Creek ranged from 0.48 at SD-36 to 5.73 at SD-52. The elevated chromium in Schoenberger Creek sediments suggests that some other source is contributing chromium to Schoenberger Creek. The presence of COPECs in upstream samples suggests that impacts to Schoenberger Creek are not related to historic smelter operation.

Sediment Summary

The sediment data suggest that surface water flow from the Facility Area may have contributed to COPEC concentrations in downgradient aquatic drainage features and water bodies. The elevated mean PEC-Q suggest that the aquatic ecosystem within Rose Creek, within close proximity to the Rose Creek Outfall, and in close proximity to the West Ditch Outfall may have been impacted by smelter-related COPECs, though as described above, the value of a PEC-Q alone cannot be used to determine whether a potential risk is present or not. Other Site-specific lines of evidence are needed to make that assessment. Moreover, based upon the presence of the metals and elevated PEC-Qs in background locations not affected by the Site, it appears that other sources such as illegal dumping, automobile emissions, roadway runoff, coal-fired power plants, and spent shot from waterfowl hunting have contributed to COPEC concentrations in sediments throughout the area.

Surface Water

Dissolved surface water concentrations were compared to acute and chronic surface water quality standards identified from the IEPA (Table 6-2). This comparison was done to assess potential impacts to the aquatic community associated with surface water and to evaluate trends in surface water chemistry in the Facility Area drainage features and downstream surface water features. Many of the surface water samples were collected in drainage features which are ephemeral in nature, including the Facility Area ditches, Rose Creek and the Rose Creek Outfall. Surface water samples from these areas were collected from very shallow, isolated and stagnant pools of water, many of which were found to hold no standing water during other parts of the year. For this reason, comparison of the surface water data to Illinois General Use Water Quality Standards is a very conservative evaluation of potential for aquatic impacts as these standards are not relevant to upland drainage ditches.

As the ditches and Rose Creek which carry surface water runoff are ephemeral, surface water samples were collected only at locations that possessed standing water. Surface water concentrations of zinc in the West Ditch #1 (SW-24) and cadmium and zinc in the West Ditch #2 (SW07) exceeded chronic and acute water quality criteria. The lead concentration in SW-7, the cadmium concentration in SW-24, and the zinc concentration in SW-12 and SW-43 exceeded chronic but not acute criteria. Within Rose Creek (SW-10, SW-11, SW-13, SW-41, and SW-44), concentrations of zinc and/or cadmium exceeded acute criteria. At the Rose Creek Outfall into the Old Cahokia Creek watershed (SW-17), only the zinc concentration slightly exceeded the acute standard (Table 6-2a). No dissolved concentrations were measured above acute and chronic standards at the West Ditch #1 outfall to the Old Cahokia Creek Watershed (SW-34) or within the Old

Cahokia Creek watershed/wetland complex. The chronic surface water criteria for selenium was slightly exceeded in one sample from Schoenberger Creek (SW-36), though selenium was not detected in any other sample from the creek and the detected concentration was below the detection limit for this analyte.

Based on the surface water chemistry study, potential risks to aquatic receptors from cadmium and zinc in ephemeral drainage ditches on the west side of the Facility Area and within the ephemeral Rose Creek and its outfall are possible. However, due to their ephemeral nature, comparison of COPC concentrations in surface water within the Facility Area ditches and Rose Creek to these standards is not appropriate. No exceedances of the acute General Use standards were found in the permanent water features in the Old Cahokia Creek wetland complex or in Schoenberger Creek.

6.1.2 Bioassays

Seven sediment samples and a control sediment sample were used in the 10 day whole sediment toxicity tests conducted using the freshwater midge, *C. tentans*. The laboratory negative control survival was 87.5%, which meets the test requirement of having at least 70% survival in the control. However, the high mortality in sediment samples collected from on and adjacent to the Site, including the reference sample, and over a range of COPEC concentrations, suggests the presence of one or more stressors in sediments, not related to the Site, caused the mortality. While elevated metals in the reference sediments (location SD-01, Table 5-1) might suggest the location is not appropriate as a reference location, it was identified as being upstream of the Site at the start of the BERA, other indigenous species, mostly aquatic worms, were found in the test sediments at the start and end of the study period, and as described below, it contained a benthic community consistent with that found in other sediments not impacted by the Facility Area.

As previously presented in Section 5.1.2, while the presence of Site-related COPECs in sediments cannot be ruled out as a contributing factor to the observed mortality, the following observations suggest that other factors were also responsible:

- 100% mortality was observed in sediments from location SD-36 in Schoenberger Creek which had a mean PEC-Q of 0.63 (less than 1.0) (Table 6-4). Given the conservative nature of the derivation of the PEC-Q, if Site-related metals were the only stressor present in sediments, little if any mortality would have been expected at this location;

- No pattern of mortality with respect to metal concentrations was observed; mortality was observed at zinc concentrations ranging from 750 mg/kg to 35,000 mg/kg; lead ranging from 70 mg/kg to 3300 mg/kg; and cadmium ranging from 19 mg/kg to 460 mg/kg;

- No pattern of mortality with respect to location was observed, the same results were obtained from all samples regardless of their location on the Site and the concentrations of COPECs within the sediments from these locations;

- Nearly all of the mortality occurred within the first 24 hours of the test while native organisms contained in the sampled sediment were noted to still be alive at the termination of the test; and,

- Ammonia in the overlying water within the treatments varied by up to 426% over the course of the test duration. This is far greater that the maximum recommended amount of variation of 50%. In addition, the startup and end ammonia concentrations were higher in the test sediments (1.0 to 5.8 mg/L) than in the lab control (0.72 mg/L), except for the Day 0 ammonia concentration was lower at SD-13 (0.42 mg/L).

Given the inconsistencies inherent in the whole sediment bioassay results, they cannot be used to draw conclusions about potential risks posed by COPECs in sediment to benthic macroinvertebrates. Fortunately, two other Site-specific lines of evidence are available (tissue analysis and benthic community analysis) and are described below.

6.1.3 Tissue Analysis

Macro-invertebrate Tissue

Potential risk to macro-invertebrate species inhabiting the drainage features and creeks was assessed by comparing COPEC concentrations measured in benthic macroinvertebrate tissue to tissue residue effect concentrations presented in peer reviewed reports (Table 6-3). Concentrations of zinc in benthic macroinvertebrate tissue samples collected from Rose Creek (SD-08) and at the West Ditch Outfall into the Old Cahokia Creek wetland complex (SD-34) exceeded the lowest observable effect concentration (LOEC); no other COPECs exceeded the No Observed Effects Concentrations (NOEC) or LOEC tissue residue levels indicating that most COPECs in macroinvertebrates at most sampled locations are not expected to pose a potential risk. This observation is consistent with the observation of native species in test sediments at the start and conclusion of the whole sediment bioassays. Tissue residue effect concentrations were not available for barium, though barium tissue concentrations were one to three orders of magnitude less than sediment concentrations.

Sample Location SD-08 is located in Rose Creek, just west of the confluence with East Ditch #1. The next downstream sample with standing water at the time of sampling (SD-13) was about 5800 ft downstream of SD-08 and is located east of Collinsville Road and east of the Rose Creek outfall into the Old Cahokia Creek wetland complex. The next upstream sample in the East Ditch (SD-06) is about 400 feet northeast of SD-08, south of East Ditch #2 confluence. Tissue concentrations were not elevated at the sample locations upstream (SD-06) or downstream (SD-13) of SD-08.

The zinc concentration in tissue at SD-34 was only slightly higher than the tissue LOEC. Sample SD-34 is at the edge of the open pond in Old Cahokia Creek Watershed, downstream of the West Ditch #1 outfall. Tissue concentrations of barium and zinc were elevated in relation to the furthest upstream sample in East Ditch #1, though zinc concentrations were lower than measured in tissue collected at SD-08. Of note is the presence of duck blinds located along the edge of the open water, just east and west of Sample Location of SW/SD-34 at the West Ditch Outfall. The ban on the use of lead shot for hunting waterfowl became nationwide in 1991; instead, non-toxic shot was approved for waterfowl hunting. Nontoxic shot is defined as any shot type that does not cause sickness and death when ingested by migratory birds. However, certain brands of non-toxic shot are approved for coatings of copper, nickel, tin, zinc, zinc chloride, and zinc chrome (*Nontoxic Shot Regulations for Hunting Waterfowl and Coots in the U.S.*, January 2006. http://www.fws.gov/migratorybirds/issues/nontoxic_shot/nontoxic.htm). Thus, the elevated zinc levels found in benthic macroinvertebrates may be attributed to waterfowl hunting within the Old Cahokia Creek watershed wetland complex.

Based on the line of evidence developed by comparing the COPEC concentrations in macroinvertebrate tissues to literature derived allowable concentrations, most COPECs at most locations do not appear to pose a potential risk to macroinvertebrates, despite PEC-Qs substantially greater than 1.0 or even 5.0 at several of these locations. The absence of toxicity is likely due to the apparently low bioavailability of metals in sediments in the vicinity of the Site (see discussion in Section 5.1.3.1). Indeed, the only COPEC the exceeded its respective allowable concentration in macroinvertebrates is zinc at two locations (SD-08 and SD-34) indicating that any potential adverse effects to macroinvertebrates appear to limited in extent and localized.

Plant Tissue

Potential risks to the plant community within the Old Cahokia Creek wetland complex was evaluated at the two discharge points of the two drainages hydraulically connected to the Facility Area: Rose Creek and West Ditch #1 outfalls.

At the Rose Creek outfall, concentrations of lead, selenium, and zinc in plants were detected at concentrations considered to be sufficient or normal (Table 5-5). The tissue concentration of cadmium was above sufficient levels but was below levels considered to be excessive or toxic.

At the West Ditch #1 outfall, concentrations of lead and selenium in herbaceous tissue samples were detected at concentrations considered to be sufficient or normal (Table 5-5). The tissue concentration of cadmium was above sufficient levels but was below levels considered to be excessive or toxic. The zinc concentration at the West Ditch outfall was higher than in the reference sample or at the Rose Creek outfall, falling within the range considered being excessive. However, the measured tissue concentration of zinc at the West Ditch outfall is considered to be tolerable in agronomic crops. Some plants have the ability to hyperaccumulate zinc in their shoots. Given the high concentration of zinc in sediments, the lower concentrations of zinc in tissue suggest that much of it is not biologically available and hyperaccumulation is not occurring, particularly given that the plant tissue sampling was highly biased towards individual specimens exhibiting overt signs of environmental stress.

Based on the plant tissue results, no significant risks are present to the plant community within the Old Cahokia wetland complex.

6.1.4 Community Studies

Community studies are another Site-specific line of evidence used to evaluate whether the aquatic ecosystem is affected by smelter-related COPECs. The potential for risk is evaluated by comparing the benthic invertebrate and wetland plant communities in the aquatic environments on and downgradient of the Facility Area with benthic invertebrate and wetland plant communities at reference locations.

6.1.4.1 Macroinvertebrates

The results of both the MBI and the TBI indices suggest that most of the area waterways are oxygen-depleted. It should be noted that there are limitations to the use of the aquatic macroinvertebrate community results presented for this Site. Not all of the aquatic macroinvertebrate families identified in Table 5-6 are assigned tolerance values. Although some of these organisms form an appreciable part of the aquatic macroinvertebrate community, they are not considered in the assessment process because the species of these families subsist, and sometimes thrive, regardless of the oxygen-depleting status of the habitat. In addition, the lack of flow and continuity of the waterways in the Site area limits the application of the benthic community indices to the evaluation of the Facility Area ditches and surrounding waters. The evaluation of the indices calculated for this Site in relation to indices for other aquatic habitats provides a conservative evaluation of potential aquatic life risks.

While the taxa richness values (5 to 18) would be low for minimally stressed waterways (Table 5-6), the taxa identified in the benthic communities on the Facility Area and surrounding drainage features generally reflect stressed conditions, especially limitations due to low dissolved oxygen. Of the 30 taxa identified, greater than half (the three snail families, the nine bug families, the three beetle families, and the mosquito family) represent species that are considered air breathers, and are not dependent on the dissolved oxygen concentrations of the waterways. When looking at the set of available metrics presented in Table 5-6, locations SD-02, SD-34 and possibly SD-13 appear to differ from the others. Given that only one sweep was conducted at SD-02, the benthic community analysis cannot be used to evaluate the health of the benthic community at that location. For the remaining locations, the community appears to be stressed but not by metals. Sample SD-13 was collected in Rose Creek and Sample SD-34 was collected at the West Ditch #1 Outfall. Of all sample locations, the lowest MBI and TBI metrics were found at

SD-13, which suggests less pollution than at the other sampling locations. The surface water collected at SW-34 had the lowest dissolved oxygen reading (Table 4-2) of all surface water sample locations.

Applying the Community Similarity Index (CSI) and Jaccard's Coefficient of Community to the Site benthic data (Table 5-7) greater similarity, as calculated by both indices, generally occurs among those benthic communities where the most taxa (13 to 18) were identified. This suggests that the commonality of the locations is not so much a distinction of which taxa the areas will support, but rather whether the locations will support any benthic macroinvertebrate taxa. Benthic macroinvertebrates found at a sampling location are likely those taxa common to the benthic communities of the area. The low similarity values occur because few taxa were found at these sampling locations.

Community loss index (CLI) values were developed for those benthic communities that can be considered to fall into a geographic continuum of a waterway. Because of the intermittent nature of Rose Creek and West Ditch # 1, there are two separate flow patterns that were assessed for the CLI metric: 1) East Ditch to upper Rose Creek and 2) Schoenberger Creek.

For East Ditch No. 1 to upper Rose Creek, the CLI values are:

East Ditch 1 at origin → East Ditch 1 at mouth of East Ditch 2, CLI = 0.31
East Ditch 1 at mouth of East Ditch 2→ Rose Creek at mouth of East Ditch 1, CLI = 0.31

For the Schoenberger Creek (S Cr) system, the CLI values are:

S Cr above Collinsville Rd → S Cr at mouth of Engineered Ditch, CLI = 0.28
S Cr at mouth of Engineered Ditch → S Cr below Engineered Ditch, CLI = 0.54

These values suggest little loss in benthic community diversity in the ditches and creeks draining the Facility Area. It should be noted that the upstream, or reference, location on East Ditch No. 1 lies on the Facility Area, and may be affected by former operations at the Facility Area. In addition, culverts connecting East Ditch #1 and East Ditch #2 were observed to be heavily clogged with sediment, effectively isolating the two ditches except under high flow conditions. Also, the upstream Schoenberger Creek location may be subject to ecological stresses not related to the former smelter in that it is situated approximately 1,000 feet downstream of a railroad yard.

In summary, the macroinvertebrate community indices suggest that most of the area waterways are generally stressed, likely due to low dissolved oxygen. Regardless, most of the benthic community metrics suggest little loss in benthic community diversity in the ditches and creeks draining the Facility Area, with the possible exception of SD-34 which had a substantially lower number of taxa and organisms than any other location.

6.1.4.2 Wetland Plants

In general, based on the wetland vegetation survey, all of the plant communities surveyed are dominated by disturbance tolerant or ruderal (weedy and adventive) species characteristic of highly altered natural environments. The wetland vegetation community assessment is provided in Attachment D. Total FQI scores for the three releve plots at the West Ditch Outfall location within the Old Cahokia Watershed ranged from 4.62 to 6.93, with slightly higher FQI scores closer to the stormwater outfall (possibly as a result of microenvironments created by frequent disturbances). Total mean C values (a measure of the native character of the community) ranged from 1.92 to 3.3. If the mean C is 3.5 or higher and/or the FQI registers in the middle thirties or higher, it is relatively certain that there is significant native character at a site to be important in terms of a regional natural area perspective.

The survey area encompasses a rather broad depositional environment that is relatively species poor and in many areas dominated by only a few herbaceous species such as redroot pigweed (*Amaranthus retroflexu)* and white grass (*Leersia virginica)* and a sparse cover of common buttonbush (*Cephalanthus occidentalis)*. Overall, native species richness was lower in the West Ditch #1 outfall (66.7 to 76.9 percent) than in the other areas surveyed. Stressed vegetation (chlorosis, malformed growth) appeared to be contained within a relatively distinct line that may potentially correlate to the depositional environment of the stormwater outfall Undisturbed hardwood swamp habitat dominated by mature black willow (*Salix nigra)* and green ash (*Fraxinus pennsylvanica)* borders the survey area on the east and west, with shrub-carr and shallow marsh habitat to the north. These higher quality habitats suggest a natural delineation of the extent of the potentially impacted area around the West Ditch Outfall.

Total FQI scores for the Rose Creek Outfall location ranged from 9.0 for the releve plot to 9.2 for the belt transect. Total mean C values ranged from 1.8 for the releve plot to 2.05 for the belt transect. Overall native species richness was about 80% for the community. Vegetation at the belt transect survey location was predominantly a disturbed wet meadow, while the plant community within the releve plot appeared to be trending successionally from a wet meadow-sedge meadow to a hardwood swamp. Beaver activity was evident in the area of the releve plot, which could partially account for the disturbed, scrub-shrub vegetation. Both sample locations are highly disturbed by stormwater flow. Although Rose Creek was dry at the time of the survey, a significant amount of trash, coarse woody debris, and sediment deposition was evident at several locations within the stream channel. Virtually no vegetation was present within the channel, which was scoured to a depth of two to three feet below the surrounding landscape. This stream downcutting has likely altered the hydrology of adjacent wetlands such as the wet meadow sampled within the belt transect, allowing species more characteristic of drier grasslands to successfully invade the plant community. Stressed vegetation (chlorosis) was evident within both sampling locations, although more localized and generally restricted to the southwest corner of the releve plot (closest to the mouth of the stream channel).

Total FQI scores and total mean C values at the Reference Area belt transect were 5.00 and 1.67, respectively, with a native species richness of about 67 percent. In contrast, the Total FQI and native species richness for the plant community were higher for the releve plot in the Reference Area (13 and 88 percent, respectively). The mean C value for the releve plot Reference Area (2.56) was also slightly higher than the belt transect location. The Reference Area is part of a former golf course that has been restored to a large floodplain wetland complex consisting of emergent and wet meadow habitats. No obvious signs of vegetative stress were observed within the Reference Area.

In summary, all of the plant communities surveyed are dominated by disturbance tolerant or ruderal (weedy and adventive) species characteristic of highly altered natural environments. None of the plant communities had mean C values of 3.5 or higher and/or FQI of 35 or higher, which would indicate significant native character. Stressed vegetation (chlorosis, malformed growth) was evident at the Rose Creek Outfall and West Ditch outfall transect locations, but appeared contained within a relatively distinct line that may potentially correlate to the depositional environment of the stormwater outfall.

6.2 UNCERTAINTY ANALYSIS

There are several sources of uncertainties associated with the ecological risk assessment process. The uncertainty analysis addresses the major assumptions that affect the degree of confidence in the estimate of risk. Knowing the uncertainties associated with the risk estimates aids the risk manager in making the Scientific/Management Decision at the end of the ecological risk assessment. General and site-specific uncertainties associated with this BERA include:

- The BERA is based on available data which, based on current practice, are assumed to be representative of Site conditions. As the number of sampling points increase, the uncertainty about the true distributions of values decreases. However, even with a large number of sampling locations, it is impossible to conclude definitively that concentrations above those measured do not exist at the Site.

- Natural and anthropogenic background levels of COPECs are likely present in samples collected from the Site. As such, Site data were compared to COPEC concentrations in sediment, surface water and tissue samples collected from reference areas. Results of this comparison are integrated into the Data Analysis Step and discussed in the Risk Characterization. Because a limited number of reference area samples were collected, the contribution from background and off-Site sources was evaluated by semi-quantitatively comparing investigative results with reference area results. An evaluation of background sediment sample locations indicates elevated levels of cadmium, lead, and zinc in reference areas. Concentrations of zinc as high as 4600 mg/kg were measured in reference samples from the West Ditch Outfall wetland complex and concentrations of zinc were as high as 3,900 mg/kg in reference samples from Rose Creek. Thus, potential Site-related risks to aquatic receptors are over-estimated because background levels of COPECs are contributing to the potential risk. Anthropogenic sources of metals that may be contributing to the total risk include hunting, illegal dumping, automobile traffic, and power plant emissions. Duck blinds are located along the edge of the open water of the Old Cahokia Wetland Complex, just east and west of the West Ditch #1 outfall. Other duck blinds are present along the open water edge further northeast of the outfall. Active hunting was noted in the watershed complex, east of the sampling activity during the December 2006 sample event. While the use of lead shot has been banned in the state of Illinois since the late 1970s, it is possible that historic shooting activity has contributed to elevated lead concentrations in the sediments of this watershed. In addition, the ban on the use of lead shot for hunting waterfowl became nationwide in 1991; instead, non-toxic shot was approved for waterfowl hunting. Nontoxic shot is defined as any shot type that does not cause sickness and death when ingested by migratory birds. However, certain brands of non-toxic shot are approved for coatings of copper, nickel, tin, zinc, zinc chloride, and zinc chrome (*Nontoxic Shot Regulations for Hunting Waterfowl and Coots in the U.S.*, January 2006. http://www.fws.gov/migratorybirds/issues/nontoxic_shot/nontoxic.htm). Thus, elevated lead and zinc levels may be attributed to waterfowl hunting within the Old Cahokia Creek watershed wetland complex.

In 1984, IEPA removed drums from the LaMear Dump within the Old Cahokia watershed wetland complex. The LaMear property is located within the Old Cahokia Wetland complex just north of Collinsville Road. According microfiche obtained the from the IEPA Bureau of Land, a total of 138 drums containing copper mud, copper scale, waste oils, enamels, solvents, and sludge wastes were illegally dumped on the LaMear property sometime between 1972 and 1975. Remediation of the area was conducted between August 20 and August 30, 1984. A total of 138 barrels were recovered and four inches of soil was removed around the barrels where excess residue had accumulated. Soil and sediment samples collected after the removal contained cadmium at 22.4 mg/kg to 43.6 mg/kg, lead at 124.7 mg/kg to 512 mg/kg, and zinc at 1703 mg/kg to 2341 mg/kg. According to the IEPA, results for soils were "below the level thought to be harmful." Thus, metal concentrations in the Old Cahokia Creek wetland complex in the vicinity of the West Ditch Outfall may partially be attributable to historic illegal dumping.

Coal-fired power plants are a major source of atmospheric mercury; Five coal fired power plants have been identified in the greater metropolitan St. Louis area. Elevated levels of mercury in sediment samples may partially be attributable to power plant emissions.

- Ranges of concentrations of trace elements required by plants are often very close to the content that exerts a harmful influenced on plant metabolism, making it hard to make a clear division between sufficient and excessive quantities of trace elements in plants (Kabata-Pendias and Pendias, 1992). Thus, the potential risks to the plant community at the outfalls may be over or under estimated.

- The mean PEC-Q method was developed to evaluate the predictive ability of PECs to determine the potential toxicity of a mixture of chemicals. The PEC database consists of samples from freshwater ecosystems throughout North America, primarily from the Great Lakes and major tributaries to the Great Lakes containing many types of chemicals, not just metals. Application of PEC to the ephemeral drainages and wetland areas associated with this Site results in an overestimation of potential risk to benthic community. The limited ability of the PEC-Q method to predict toxicity at this Site is demonstrated by mean PEC-Q of up to 5.4 within reference areas of the Old Cahokia Watershed.

- There are limitations to the use of the aquatic macroinvertebrate community results due to the families identified and the ephemeral nature of the water bodies. Not all of the aquatic macroinvertebrate families identified are assigned tolerance values. Although some of these organisms form an appreciable part of the aquatic macroinvertebrate community, they are not considered in the assessment process because the species of these families subsist, and sometimes thrive, regardless of the oxygen-depleting status of the habitat. Many of the aquatic bug and beetle species and some of the aquatic fly larvae families are air breathers, so the waters' dissolved oxygen concentrations will have little or no effect on the health of these species. Fourteen of the 30 identified taxa have species that are air breathers, and thus provide limited information for a biological assessment of the aquatic macroinvertebrate communities. Though it bears mentioning that whether an invertebrate is an air breather or not, may not have any effect on its sensitivity to metal toxicity and, thus, the presence of air breathers in the waterways around the Site may only be an indication of limited dissolved oxygen and not of stress caused by elevated levels of metals.

6.3 RISK DESCRIPTION

The risk description provides information to aid in interpreting the potential risks and, if appropriate and necessary, to identifying concentrations that are protective of the assessment endpoints, or conversely, above which adverse effects may be observed. The risk description also provides information to help the risk manager judge the likelihood and ecological significance of the estimated potential risks. At the completion of the risk characterization, a Scientific Management Decision Point (SMDP) occurs. Decisions are made by the risk manager concerning what future actions, if any, are to be undertaken.

The objective of the BERA was to determine whether smelter-related COPECs have adversely affected the aquatic ecosystems within the ephemeral drainage features draining the Facility Area and aquatic ecosystem in the immediate vicinity of the discharges areas within the Old Cahokia Creek Watershed. To meet this objective, the BERA:

- Evaluated COPECs concentrations in sediment, surface water, and macroinvertebrate and wetland plant tissues; and,

- Assessed the potential for adverse effects to ecological receptors, focusing on exposures to aquatic invertebrate and wetland plant communities, using sediment and surface water sampling, laboratory bioassays, tissue sampling, and community studies;

Generally, more than one line of evidence is used to evaluate whether chemicals from a site are potentially affecting the assessment endpoint(s). Lines of evidence that were used to characterize potential risk in this BERA include:

- Comparing measured COPEC concentrations in sediment and surface water to conservative screening levels;

- Comparing results from whole sediment bioassays conducted with sediment from the Site with bioassays conducted with sediment from a reference location;

- Comparing tissue metals concentrations of benthic macroinvertebrates and plants collected from areas potentially affected by the Facility Area to tissue concentrations from a reference location and to tissue concentrations from the literature that are reported to be allowable toxic; and,

- Comparing the benthic invertebrate and wetland plant communities in the areas potentially affected by the Facility Area to the benthic invertebrate and wetland plant communities at reference locations.

Table 6-4 summarizes the multiple lines of evidence for the 10 ecological sampling locations used to assess potential effects in the aquatic ecosystems within the ephemeral drainage features draining the Facility Area and the aquatic ecosystem in the immediate vicinity of the discharges areas within the Old Cahokia Creek Watershed. As noted above, because of concerns about the reliability of the results of the whole sediment bioassays, those results are not used as a line of evidence in the risk characterization contained in the BERA, though the results of the bioassays are summarized in Table 6-4.

Comparison of the surface water and sediment chemistry data from East Ditch #1 and #2, to conservative benchmarks suggests that potential adverse effects to aquatic organisms may exist (Table 6-4). However, the benthic community survey shows a similar community throughout the Facility Area ditches that is similar to the community found in Schoenberger Creek which is not affected by releases from the Facility Area. In addition, COPEC concentrations in macroinvertebrate tissues were below NOECs and LOECs suggesting COPEC concentrations were not high enough to pose a potential risk. The absence of a potential risk is supported by the observation of native organisms in sediments during the bioassay. Thus, while comparison of surface water and sediment chemistry to conservative and generic benchmarks suggests potential impacts to the aquatic ecosystem in the East Ditches, all of the Site-specific lines of evidence suggest the absence of an effect related to COPECs, given the current characteristics of the East Ditches. The ditches have been altered to enhance stormwater flow on the Facility Area. Piles of slag and slag-like material are present along the banks of the ditches. Overall, given the physical characteristics and ephemeral conditions of the Facility Area ditches, the aquatic communities would likely change little if the metals were removed from the systems.

As with the East Ditches, comparison of the surface water and sediment chemistry data from Rose Creek to conservative benchmarks suggests that potential adverse effects to aquatic organisms may exist, with greater potential for impact at the location closest to the Facility Area (Table 6-4). This is consistent with the comparison of macroinvertebrate tissue concentrations to allowable benchmarks, which also suggest a potential impact in the upstream Rose Creek location (SD-08) and no impact at the downstream location (SD-13). However, the benthic community metrics suggest the opposite trend, a more diverse and abundant community in the upstream Rose Creek sampling location than at the downstream location. During the whole sediment bioassay tests, native species were also noted in the upstream but not at the downstream location. Overall, the benthic macroinvertebrate community in both Rose Creek sampling locations appears to be similar to that found at other sampling locations in the vicinity of the Site, including the locations on Schoenberger Creek not affected by the Site. Thus, while comparison of surface water and sediment chemistry to conservative and generic benchmarks suggests potential impacts to the aquatic ecosystem in Rose Creek, most of the Site-specific lines of evidence suggest the absence of an effect related to COPECs, given the current characteristics of Rose Creek. Rose Creek is a relatively narrow ephemeral stream that flows along the north side of the Penn Central & Baltimore/Ohio Rail Corridor. Slag and slag-like material are present along the banks where Rose Creek flows through and adjacent to the Facility Area. Given the physical characteristics and ephemeral conditions of Rose Creek, the aquatic communities would likely change little if the metals were removed from the systems.

Some overt effects on plant growth (e.g., chlorosis) were observed at the Rose Creek outfall, though this was localized. Plant tissue concentrations at Rose Creek outfall were below levels that are considered toxic. Nevertheless, impacts to the plant community from smelter-related COPECs on the plant community in the immediate vicinity of the Rose Creek outfall are possible, though the results also suggest that these effects are limited in spatial extent.

As with Rose Creek and the East Ditches, comparison of the surface water and sediment chemistry data from the West Ditch Outfall into the Old Cahokia wetland complex to conservative benchmarks suggests that potential adverse effects to aquatic organisms may exist (Table 6-4). However, unlike for the other two water bodies, the Site-specific lines of evidence also suggest a potential impact to the benthic macroinvertebrate community. The total number of organisms and taxa are lower at this outfall location than at the other sample locations and the macroinvertebrate indices higher, indicating a less healthy community and poorer water quality. In addition, the concentration of zinc in invertebrate tissues is slight greater than the allowable benchmark. Thus, COPECs as this location may be adversely affecting the benthic macroinvertebrate community. Additionally, some overt effects on plant growth (e.g., chlorosis) were observed at this outfall, though this was limited to a very localized areas but is consistent with the concentration of zinc in plant tissues being within the range considered to be excessive or toxic. All other metals were below levels that are considered toxic. These lines of evidence suggest that COPECs may be adversely affecting the aquatic ecosystem at the West Ditch outfall, though the results also suggest that these effects are limited in spatial extent.

While the surface water and sediment chemistry suggests some impact to aquatic organisms within Schoenberger Creek (Table 6-4), COPEC concentrations do not appear elevated compared to the reference location in the creek. The benthic community survey shows that the community within the creek is similar to the sampling locations in the reference area as well as to locations in the Facility Area ditches. Native organisms were found in sediments during the whole sediment bioassay and COPECs in benthic macroinvertebrate tissues were below NOECs and LOECs. Thus, there is no evidence that any smelter-related COPECs have impacted Schoenberger Creek.

The BERA has taken the multiple lines of chemistry available at the ten locations discussed above for use and extending the findings to all locations where we only have chemistry. In summary, sediment chemistry data show that surface water flow from the Facility Area has resulted in COPEC migration to some of the down-gradient aquatic habitats within the Old Cahokia Watershed, within the immediate vicinity of the West Ditch and Rose Creek Outfalls, though other anthropogenic sources have also contributed COPECs at these locations. The lines of evidence presented in the BERA suggest that smelter-related COPECs may be affecting the macroinvertebrate community in a localized area downgradient of the West Ditch outfall at the edge of the open water habitat at sample location SD-34. In addition, some evidence suggests that smelter-related COPECs are affecting wetland plants in localized areas downgradient of the West Ditch and Rose Creek Outfalls. Potential effects to plants are localized and are not affecting the overall plant community; only individual plants in the immediate vicinity of outfalls. In conclusion, with the exception of the localized findings noted above, the BERA has developed no conclusive evidence that the diversity and viability of the aquatic ecosystem in the drainage features draining the Facility Area and the aquatic ecosystem in the immediate vicinity of the discharges areas within the Old Cahokia

Creek Watershed is being adversely affected by COPECs associated with historic smelter activities.

7.0 REFERENCES

American Society for Testing and Materials. 2000. *Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates.* ASTM E1706-95b.

Bechtel Jacobs Company LLC. 1998. *EBiota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation.* Bechtel Jacobs Company LLC, Oak Ridge, Tennessee. BJC/OR-112.

ENTACT, 2006. *Support Sampling Plan for the Old American Zinc Plant Site, Fairmont City, Illinois, Revision 2*, 71 pp.

Fenneman, N.M., 1910. *Physiography of the St. Louis Area, Bulletin No. 12* (Willman, 1975) Illinois State Geological Survey (ISGS), University of Illinois, Urbana, Illinois.

Hilsenhoff, W.L., 1982. *Using a Biotic Index to Evaluate Water Quality in Streams,* Wisconsin Department of Natural Resources Technical Bulletin No. 132, 22 pp.

Hilsenhoff, W.L., 1987. An Improved Biotic Index of Organic Stream Pollution, *The Great Lakes Entomologist*, 20(1):31-39.

Hilsenhoff, W.L., 1988. Rapid Field Assessment of Organic Pollution with a Family-level Biotic Index, *Journal of the North American Benthological Society*, 7:65-68.

Hilsenhoff, W.L., 1998. A Modification of the Biotic Index of Organic Stream Pollution to Remedy Problems and Permit Its Use throughout the Year, *The Great Lakes Entomologist*, 31(1):1-12.

Illinois Environmental Protection Agency, 2002. *Water Monitoring Strategy 2002-2006*, Publication IEPA/BOW/02-005.

Illinois State Geological Survey (ISGS), March 14, 2003. "Fairmont City Potential Wetland Compensation Site: Hydrogeologic Characterization Report, Collinsville Road, Fairmont City." Prepared for Illinois Department of Transportation, Bureau of Design and Environment, Wetlands Unit.

Ingersoll, C.G., D.D. MacDonald, N. Wang, J.L. Crane, L.J. Field, P.S. Haverland, N.E. Kemble, R.A. Lindskoog, C. Severn, and D.E. Smorong. 2000. Prediction of toxicity using consensus-based freshwater sediment quality guidelines. U.S. EPA Great Lakes National Program Office. EPA-905/R-00/007.

REFERENCES CONTINUED

Ingersoll, C.G., D.D. MacDonald, N. Wang, J.L. Crane, L.J. Field, P.S. Haverland, N.E. Kemble, R.A. Lindskoog, C. Severn, and D.E. Smorong. 2001. Predictions of sediment toxicity using consensus based freshwater sediment quality guidelines. Arch. Environ. Contam. Toxicol. 41:8-21.).

Lillie, R.A., and R.A. Schlesser, 1994. Extracting Additional Information from Biotic Index Samples, *The Great Lakes Entomologist*, 27(3):129-136.

Kabata-Pendias, Alina and Henryk Pendias. 1992. *Trace Elements in Soils and Plants*, 2nd Edition. CRC Press. Boca Raton, FL.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems". *Arch. Environ. Contam. Toxicol. 39: 20-31.*

Matthews, J.W., P.A. Tessene, S.C. Wiesbrook, and B.W. Zercher. 2005. Effect of area and isolation on species richness and indices of floristic quality in Illinois, USA wetlands. Wetlands. 25:3 (607-615).

M.T. Bosko & Associates, 2006. *Baseline Ecological Risk Assessment Work Plan for the Old American Zinc Plant Site, Fairmont City, Illinois*, 18 pp.

Ontario Ministry of Environment (OMOE). 2002. *Soil Investigation and Human Health Risk Assessment for the Rodney Street Community, Port Colborne*, Publication # 4255e, http://www.ene.gov.on.ca/envision/land/portcolborne/4255e.htm

Swink, F. and G. Wilhelm. 1994. *Plants of the Chicago Region, 4th Edition.* Indianapolis: Indiana Academy of Science.

Taft, J.B., C. Hauser, and K. R. Robertson. 2006. Estimating floristic integrity in tallgrass prairie. Biological Conservation. 131:42-51.

Taft, J.B., G.S. Wilhelm, D.H. Ladd, and L.A. Masters. 1997. Floristic quality assessment for vegetation in Illinois: a method for assessing vegetation integrity. Erigenia. 15:3-95.

U.S. Environmental Protection Agency (EPA). 1990. Biological Criteria: National Program Guidance for Surface Waters. Office of Water Regulations and Standards. U.S. EPA, Washington D.C. EPA-440/5-90-004.

REFERENCES CONTINUED

U.S. Environmental Protection Agency (EPA). 1992a. *Framework for Ecological Risk Assessment.* EPA/630/R-92/001.

U.S. Environmental Protection Agency (EPA). 1992b. *Sediment Classification Methods Compendium.* EPA 823-R-92-006.

U.S. Environmental Protection Agency (EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments - Interim Final.* EPA 540-R-97-006.

U.S. Environmental Protection Agency (EPA). 1998. *Guidelines for Ecological Risk Assessment* (EPA, 1998). EPA/630/R-95/002F.

U.S. Environmental Protection Agency (EPA). 1999. *Ecological Risk Assessment and Risk Management Principles for Superfund Sites.* OSWER Directive 9285.7-28P.

U.S. Environmental Protection Agency (EPA). 2000. (*Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates.* EPA 600/R-99/064.

U.S. Environmental Protection Agency (EPA). 2002a. *Methods for Evaluating Wetland Condition #10 - Using Vegetation to Assess Environmental Conditions in Wetlands.* Office of Water. EPA-822-R-02-202.

U.S. Environmental Protection Agency Region IV, 2002b. *Ecological Assessment Standard Operating Procedures and Quality Assurance Manual, 2002.*

U.S. Environmental Protection Agency Region V (EPA). 2004. Mercury Emissions from Motor Vehicles. http://www.epa.gov/ttn/chief/conference/ei13/toxics/hoyer.pdf.

U.S. Environmental Protection Agency Region V (EPA). 2005. *Superfund Ecological Risk Assessment 8-step Overview* (EPA, 2005). Last updated on Monday, January 3, 2005. http://www.epa.gov/region5superfund/ecology/html/8stepera.html

Wilhelm, G. and D. Ladd. 1988. Natural areas assessment in the Chicago region. *Transaction of the North American Wildlife and Natural Resources Conference.* 53:361-375.

Wisconsin Department of Natural Resources (WDNR). 2003. *Consensus-Based Sediment Quality Guidelines Recommendations for Use & Application Interim Guidance.* Developed by the Contaminated Sediment Standing Team. December 2003. WT-732 2003.

ENTACT

Tables

Tables

Table 3-1
Assessment and Measurement of Endpoints
Former American Zinc Plant Site, Fairmont City

Feeding Guild	Assessment Endpoint	Endpoint Objective	Surrogate Species or Community	Measures of Exposure
Benthic organisms	Benthic invertebrates are an important food source for many higher trophic level predators. They also provide an important role as decomposers/detritivores in nutrient cycling. *Assessment endpoint = preservation of the health and diversity (taxa richness and abundance) of benthic organisms.*	Are heavy metals in sediment and surface water adversely affecting benthic communities? Are heavy metals bioaccumulating in benthic organisms? Are heavy metals toxic to benthic organisms? Have heavy metals impacted the benthic macroinvertebrate community?	Benthic organisms	Comparison of sediment and aqueous media concentrations with toxicity-based screening values. Tissue concentrations in benthos. *Chironomus tentans* 10-day bioassay. Benthic community structure and function assessment and reference area comparison.
Wetland plants	Wetland plants are an important food source for higher trophic level aquatic consumers and wildlife. Rooted vegetation also provides habitat and bottom stability *Assessment endpoint = preservation of the health and diversity (taxa richness and abundance) of wetland plants.*	Are heavy metals in sediment and surface water adversely affecting wetland plant populations? Are heavy metals bioaccumulating in plants? Have heavy metals impacted the wetland plant community?	Wetland plants	Comparison of sediment and aqueous media concentrations with toxicity-based screening values. Tissue concentrations in wetland plants. Community analysis (e.g., species richness and dominance, percent cover, floristic quality assessment) and reference area comparison.

TABLE 4.1
SUMMARY OF SURFACE WATER AND SEDIMENT SAMPLES COLLECTED FOR CHEMICAL ANALYSES
FORMER AMERICAN ZINC PLANT SITE
FAIRMONT CITY, ILLINOIS

SAMPLE	DATE	TIME	MATRIX	DEPTH (feet)	ANALYTICAL PAREMETERS [1]	DESCRIPTION
EAST DITCH #1						
SD-01-0.5	5/31/2006	1030	SED	0.0 - 0.5	Metals, Pest.	North end of ditch.
SW-01	5/31/2006	1000	SW	0.0 - 0.5	Metals, Pest.	
	6/29/2006	1645	SW	0.0 - 0.5	Hardness	
SD-05-0.5	5/31/2006	0955	SED	0.0 - 0.5	Metals, Pest.	Confluence with Ditch #2.
SW-05	5/31/2006	0945	SW	0.0 - 0.5	Metals, Pest.	
	6/29/2006	1700	SW	0.0 - 0.5	Hardness	
SD-06-0.5	5/31/2006	0920	SED	0.0 - 0.5	Metals	South of East Ditch #2 confluence.
SW-06	5/31/2006	0910	SW	0 0 - 0 5	Metals	
EAST DITCH #2						
SD-02-0.5	5/31/2006	1110	SED	0.0 - 0.5	Metals	East end of ditch.
ROSE CREEK - UPSTREAM OF FACILITY						
SD-04-0.5	6/1/2006	1030	SED	0.0 - 0.5	Metals, Pest.	SW corner of Cargill facility, East of East Ditch #1 confluence.
RSD-1	7/17/2007	1127	SED	0.0 - 0.5	Metals	Near SE corner of Cargill facility, east of Kings Highway.
RSD-2	7/17/2007	1130	SED	0.0 - 0.5	Metals	Near SE corner of Cargill facility, east of Kings Highway, west of RSD-1.
RSD-3	7/17/2007	1140	SED	0.0 - 0.5	Metals	Near SE corner of Cargill facility, west of Kings Highway.
RSD-4	7/17/2007	1149	SED	0.0 - 0.5	Metals	Near SE corner of Cargill facility, west of Kings Highway and RSD-3
ROSE CREEK BORDERING FACILITY						
SD-08-0.5	5/31/2006	0820	SED	0.0 - 0.5	Metals, Pest.	Just west of East Ditch #1 confluence.
SW-08	5/31/2006	0810	SW	0.0 - 0.5	Metals, Pest.	
	6/29/2006	1705	SW	0.0 - 0.5	Hardness	
ROSE CREEK - DOWNSTREAM OF FACILITY						
SD-09-0.5	5/30/2006	1630	SED	0.0 - 0.5	Metals, Pest.	At base of discharge pipe for combined discharge of West Ditch #1 and #2 into Rose Creek. (In erosion pool in bed of Rose Creek, created by discharge from west ditch outfall.)
SW-41	12/12//2006	1345	SW	0.0 - 0.5	Metals, Hardness	10.5 feet SW of SD-10. (Downstream edge of erosion pool in bed of Rose Creek, created by discharge from west ditch outfall.)
SW-41-D	12/12//2006	1345	SW	0.0 - 0.5	Metals, Hardness	
SW-41-Resample	7/19/2007	0910	SW	0.0 - 0.5	Metals	
SW-41-Resample - D	7/19/2007	0910	SW	0.0 - 0.5	Metals	
SD-41	12/12//2006	1350	SED	0.0 - 0.5	Metals	
SD-41-D	12/12//2006	1350	SED	0.0 - 0.5	Metals	
SW-42	12/12//2006	1400	SW	0.0 - 0.5	Metals, Hardness	129 feet downstream (WSW) of SW/SD-41
SD-42	12/12//2006	1405	SED	0.0 - 0.5	Metals	
SD-10-0.5	6/12/2006	1355	SED	0.0 - 0.5	Metals	326 feet downstream (WSW) of 09.
SW-10	6/12/2006	1345	SW	0.0 - 0.5	Metals	
SD-11-0.5	6/12/2006	1330	SED	0.0 - 0.5	Metals	1482 feet downstream (WSW) of 09.
SW-11	6/12/2006	1320	SW	0.0 - 0.5	Metals	
SD-12-0.5	6/12/2006	1550	SED	0.0 - 0.5	Metals	2769 feet downstream (WSW) of 09.
SD-12/FD	6/12/2006	1550	SED	0.0 - 0.5	Metals	
SW-12	6/12/2006	1545	SW	0.0 - 0.5	Metals	
SW-12/FD	6/12/2006	1545	SW	0.0 - 0.5	Metals	
SW-43	12/12//2006	1440	SW	0.0 - 0.5	Metals, Hardness	225 feet upstream (SE) of 13.
SW-43-Resample	7/18/2007	1136	SW	0.0 - 0.5	Metals	
SD-43	12/12//2006	1445	SED	0.0 - 0.5	Metals	
SW-44	12/12//2006	1450	SW	0.0 - 0.5	Metals, Hardness	144 feet upstream (SE) of 13.
SW-44 Resample	7/18/2007	1154	SW	0.0 - 0.5	Metals	
SD-44	12/12//2006	1452	SED	0.0 - 0.5	Metals	
SD-13-0.5	6/12/2006	1117	SED	0.0 - 0.5	Metals	4452 feet downstream (west) of 09.
SW-13	6/12/2006	1117	SW	0.0 - 0.5	Metals	
SD-13-R	12/14/2006	1015	SED	0.0 - 0.5	Grain size distribution, TOC	
ROSE CREEK OUTFALL						
SD-14-0.5	6/12/2006	1018	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 18 feet E of SD-16.
SD-15-0.5	6/12/2006	1015	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 10.9 feet E of SD-16 and W of SD-14.
SD-16-0.5	6/12/2006	1020	SED	0.0 - 0.5	Metals	In main ditch channel. No standing water.
SD-17-0.5	6/12/2006	1040	SED	0.0 - 0.5	Metals	West edge of ditch channel, 11.2 feet SW of SD-16. Standing water present.
SW-17	6/12/2006	1040	SW		Metals	
SD-18-0.5	6/12/2006	1030	SED	0 0 - 0.5	Metals	Outside of and above ditch channel, 18.9 feet SW of SD-16.
CAHOKIA CREEK WATERSHED NEAR ROSE CREEK OUTFALL						
TRC-2-S1-0-6	7/19/2007	1055	SED	0.0 - 0.5	Metals	Marsh wetlands NW of scour channel created by Rose Creek Outfall, approx. 350 feet NW of outfall.
CAHOKIA CREEK WATERSHED IMPOUNDMENTS						
TRC-1-N-0-6	7/18/2007	1615	SED	0.0 - 0.5	Metals	Lake C, northeast bank.
TRC-1-N-6-8	7/18/2007	1615	SED	0.5 - 0.7	Metals	
TRC-2-N-0-6	7/18/2007	1535	SED	0.0 - 0.5	Metals	Lake B, west bank.
TRC-2-N1-0-6	7/18/2007	1512	SED	0.0 - 0.5	Metals	Lake B, bank.at SW corner.
TRC-2-N1-6-8	7/18/2007	1512	SED	0.5 - 0.7	Metals	
TRC-2-C-0-6	7/18/2007	1535	SED	0.0 - 0.5	Metals	Small pond in wooded area S of Lake B.
TRC-2-C-10-12	7/18/2007	1535	SED	0.8 - 1.0	Metals	
TRC-3-N-0-6	7/18/2007	1700	SED	0.0 - 0.5	Metals	Lake A, north bank.
TRC-3-N-0-6 FD	7/18/2007	1700	SED	0.0 - 0.5	Metals	
TRC-3-N-8-10	7/18/2007	1700	SED	0.7 - 0.8	Metals	

TABLE 4.1 (Continued)
SUMMARY OF SURFACE WATER AND SEDIMENT SAMPLES COLLECTED FOR CHEMICAL ANALYSES
FORMER AMERICAN ZINC PLANT SITE
FAIRMONT CITY, ILLINOIS

SAMPLE	DATE	TIME	MATRIX	DEPTH (feet)	ANALYTICAL PAREMETERS [1]	DESCRIPTION
CAHOKIA CREEK WATERSHED - CAHOKIA CREEK AND ENGINEERED DRAINAGE DITCH						
SW-50	7/19/2007	1500	SW	0.0 - 0.5	Metals	Cahokia Creek, immediately south of Interstate
SD-50-0-6	7/18/2007	0940	SED	0.0 - 0.5	Metals	
SD-50-8-10	7/18/2007	0940	SED	0.8 - 0.9	Metals	
SD-51DITCH-0-6	7/18/2007	0925	SED	0.0 - 0.5	Metals	Engineered Drainage Ditch, immediately south of Interstate
SD-51DITCH-8-10	7/18/2007	0925	SED	0.8 - 0.9	Metals	
SD-51DITCH-12-14	7/18/2007	0925	SED	1.0 - 1.2	Metals	
TRC-2-S-0-6	7/18/2007	0905	SED	0.0 - 0.5	Metals	Engineered Drainage Ditch, NW of Rose Creek Outfall
TRC-2-S-8-10	7/18/2007	0905	SED	0.8 - 0.9	Metals	
TRC-2-S-12-14	7/18/2007	0905	SED	1.0 - 1.2	Metals	
TRC-3-S-0-6	7/18/2007	0940	SED	0.0 - 0.5	Metals	Wetlands east of Schoenberger Creek
TRC-3-S-7-9	7/18/2007	0940	SED	0.6 - 0.8	Metals	
SW-TRC-3-S-	7/19/2007	1315	SW	0.0 - 0 5	Metals	
CAHOKIA CREEK WATERSHED - OTHER						
TRC-1-S-0-6	7/19/2007	1130	SED	0.0 - 0.5	Metals	Wetland east of Engineered Drainage Ditch, NE of Rose Creek Outfall (Note this sample was NOT located within the Engineered Drainage Ditch).
TRC-1-S-0-6 FD	7/19/2007	1130	SED	0.0 - 0.5	Metals	
TRC-1-S-6-8	7/19/2007	1120	SED	0.5 - 0.6	Metals	
WEST DITCH #2						
SW-07	6/2/2006	1400	SW	0.0 - 0.5	Metals	North end of ditch.
SW-07-FD	6/2/2006	1400	SW	0.0 - 0.5	Metals	
SD-07-0.5	6/2/2006	1410	SED	0.0 - 0.5	Metals	
SD-07-0.5/FD	6/2/2006	1410	SED	0.0 - 0.5	Metals	
WEST DITCH #1						
SD-23-0.5	6/2/2006	1345	SED	0.0 - 0.5	Metals	West edge of facility, approximately 750 feet north of 09.
SD-23-0.5/FD	6/2/2006	1345	SED	0.0 - 0.5	Metals	
SD-24-0.5	6/1/2006	1420	SED	0.0 - 0.5	Metals, Pest.	West edge of facility, 1216 feet north of 09.
SW-24	6/1/2006	1410	SW	0.0 - 0.5	Metals, Pest.	
SD-25-0.5	6/1/2006	1145	SED	0.0 - 0.5	Metals	West edge of facility, 2045 feet north of 09.
SD-25-0.5/FD	6/1/2006	1145	SED	0.0 - 0.5	Metals	
SD-26-0.5	6/1/2006	1135	SED	0.0 - 0.5	Metals	NW edge of facility, 306 feet SW of 27.
SD-27-0.5	6/1/2006	1115	SED	0.0 - 0.5	Metals	At northwest corner of facility.
SD-28-0.5	6/1/2006	1100	SED	0.0 - 0.5	Metals	Off-site, 290 feet NW of 27
WEST DITCH OUTFALL AND DOWNGRADIENT WET MEADOW/MARSH						
SD-29-0.5	6/1/2006	0845	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 27 feet east of SD-31.
SD-30-0.5	6/1/2006	0855	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 11.4 feet ENE of SD-31, west of SD-29.
SD-31-0.5	6/1/2006	0905	SED	0.0 - 0.5	Metals	In ditch channel downstream of outfall point north of Collinsville Road. Standing water present.
SD-32-0.5	6/1/2006	0910	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 16.5 feet SW of SD-31.
SD-33-0.5	6/1/2006	0920	SED	0.0 - 0.5	Metals	Outside of and above ditch channel, 30 feet SSW of SD-31.
SD-034	6/28/2006	1535	SED	0.0 - 0.5	Metals	Edge of open pond in Old Cahokia Creek Watershed, 351 feet NW of 31.
SD-034-D	6/28/2006	1535	SED	0.0 - 0.5	Metals	
SW-34	6/28/2006	1530	SW	0.0 - 0.5	Metals, Hardness	
SW-34-D	6/28/2006	1530	SW	0.0 - 0.5	Metals, Hardness	
SW-45	12/12/2006	1100	SW	0.0 - 0.5	Metals, Hardness	Between West Ditch Outfall and edge of open water, 154 feet NNW of 31.
SD-45	12/12/2006	1105	SED	0.0 - 0.5	Metals	
SD-46	12/13/2006	1431	SED	0.0 - 0.5	Metals	NNE of SW/SD-45.
SD-47	12/13/2006	1437	SED	0.0 - 0.5	Metals	NNW of SW/SD-45.
SD-48	12/13/2006	1448	SED	0.0 - 0.5	Metals	WNW of SW/SD-45.
CAHOKIA CREEK WATERSHED NEAR WEST DITCH OUTFALL						
SW-38	12/12//2006	1110	SW	0.0 - 0.5	Metals, Hardness	175 feet ENE of SW/SD-34, along south edge of open water.
SW-38 Resample	7/18/2007	0949	SW	0.0 - 0.5	Metals	
SD-38	12/12//2006	1115	SED	0.0 - 0.5	Metals	
SD-38-R	12/13/2006	1500	SED	0.0-0.5	Grain size distribution, TOC	
SW-39	12/12//2006	1120	SW	0.0 - 0.5	Metals, Hardness	73 feet NE of SW/SD-38, along south edge of open water.
SW-39 Resample	7/18/2007	1007	SW	0.0 - 0.5	Metals	
SD-39	12/12//2006	1125	SED	0.0 - 0.5	Metals	
SW-40	12/12//2006	1130	SW	0.0 - 0.5	Metals, Hardness	46 feet NE of SW/SD-39, along south edge of open water.
SW-40 Resample	7/18/2007	1024	SW	0.0 - 0.5	Metals	
SD-40	12/12//2006	1135	SED	0.0 - 0.5	Metals	
TWD-1-N-0-6	7/17/2007	1030	SED	0.0 - 0.5	Metals	Transect TWD-1, northern edge of open water.
TWD-1-N-6-8	7/17/2007	1030	SED	0.5 - 0.7	Metals	
TWD-1-C-0-6	7/17/2007	1105	SED	0.0 - 0.5	Metals	Transect TWD-1, center of open water, SE of TWD-!-N.
TWD-1-C-6-10	7/17/2007	1105	SED	0.5 - 0.8	Metals	
TWD-1-S-0-6	7/17/2007	1125	SED	0.0 - 0.5	Metals	Transect TWD-1, southern edge of open water, SE of TWD-1-C.
TWD-1-S-6-9.5	7/17/2007	1125	SED	0.5 - 0.8	Metals	
TWD-2-N-0-6	7/17/2007	1535	SED	0.0 - 0.5	Metals	Transect TWD-2, northern edge of open water.
TWD-2-N-6-7	7/17/2007	1535	SED	0.5-0.6	Metals	
TWD-2-C-0-6	7/17/2007	1512	SED	0.0 - 0.5	Metals	Transect TWD-2, center of open water, SE of TWD-2-N.
TWD-2-C-6-9	7/17/2007	1512	SED	0.5 -0.8	Metals	
TWD-2-C-6-9 DUP	7/17/2007	1512	SED	0.5 -0.8	Metals	
TWD-2-S-0-6	7/17/2007	1455	SED	0.0 - 0.5	Metals	Transect TWD-2, southern edge of open water, NE of SW/SD-34TWD-1-C.
TWD-2-S-6-8	7/17/2007	1455	SED	0.5 - 0.7	Metals	
TWD-3-N-0-6	7/17/2007	1635	SED	0.0 - 0.5	Metals	Transect TWD-3, northern edge of open water.
TWD-3-N-6-8	7/17/2007	1635	SED	0.5 - 0.7	Metals	

TABLE 4.1 (Continued)
SUMMARY OF SURFACE WATER AND SEDIMENT SAMPLES COLLECTED FOR CHEMICAL ANALYSES
FORMER AMERICAN ZINC PLANT SITE
FAIRMONT CITY, ILLINOIS

SAMPLE	DATE	TIME	MATRIX	DEPTH (feet)	ANALYTICAL PAREMETERS [1]	DESCRIPTION
CAHOKIA CREEK WATERSHED NEAR WEST DITCH OUTFALL (Cont.						
TWD-3-C-0-6	7/17/2007	1620	SED	0.0 - 0.5	Metals	Transect TWD-3, center of open water, SE of TWD-3-N.
TWD-3-C-6-8.5	7/17/2007	1620	SED	0.5 - 0.7	Metals	
TWD-3-S-0-6	7/17/2007	1600	SED	0.0 - 0.5	Metals	Transect TWD-3, southern edge of open water, SE of TWD-3-C.
TWD-3-S-6-8	7/17/2007	1600	SED	0.5 - 0.7	Metals	
TWD-3-S-10-12	7/17/2007	1600	SED	0.8 - 1.0	Metals	
CHOENBERGER CREEK						
SD-20-0.5	6/13/2006	0905	SED	0.0 - 0.5	Metals	Between two discharge structures draining water from Old Cahokia Creek Watershed into creek, east side of creek.
SD-20-0.5/FD	6/13/2006	0905	SED	0.0 - 0.5	Metals	
SW-20	6/13/2006	0855	SW	0.0 - 0.5	Metals	
SW-20/FD	6/13/2006	0855	SW	0.0 - 0.5	Metals	
SD-21-0.5	6/12/2006	0900	SED	0.0 - 0.5	Metals	Between two discharge structures draining water from Old Cahokia Creek Watershed into creek, east side of creek, downstream of 20.
SW-21	6/12/2006	0900	SW	0.0 - 0.5	Metals	
SD-22-0.5	6/13/2006	0932	SED	0.0 - 0.5	Metals	Approximately 120 feet upstream (south) of Collinsville Road.
SW-22	6/13/2006	0925	SW	0.0 - 0.5	Metals	
SD-36	6/29/2006	0835	SED	0.0 - 0.5	Metals	At northern-most discharge structure draining water from watershed on the NE side of the creek.
SW-36	6/29/2006	0830	SW	0.0 - 0.5	Metals, Hardness	
SD-037	6/29/2006	0930	SED	0.0 - 0.5	Metals	Approximately 125 feet downstream of 36, on SW side of creek.
SW-37	6/29/2006	0925	SW	0.0 - 0.5	Metals, Hardness	
SD-52	7/18/2007	1045	SED	0.0 - 0.5	Metals	West of Highway 203.
SW-52	7/19/2007	1340	SW	0 0 - 0.5	Metals	
OTHER						
SD-03-0.5	6/1/2006	1010	SED	0.0 - 0.5	Metals, Pest.	Ditch along west side of Kingshighway. Direction of runoff flow at this point is indeterminate.

1 - Metals parameters included the RCRA 8 parameters and zinc. Surface water samples were analyzed for both total and dissolved concentrations of these metals. Samples collected in December 2006 and July 2007 also included copper.

TABLE 4-2
SUMMARY OF YSI READINGS
Former American Zinc Plant Site
Fairmont City, Illinois

DATE	TIME	SAMPLE LOCATION	DEPTH (ft)	pH	CONDUCTIVITY (MMHOS/CM)	TEMPERATURE (°C)	DO (mg/L)	ORP (mV)
6/28/2006	825	SW-06	1.8	7.2	292	22.82	1.72	-159.8
6/28/2006	910	SW-01	0.8 – 1.3	7.22	213	19.87	1.19	-119.4
6/28/2006	950	SW-05	0.5- 0.6	7.21	294	22.4	5.03	-13.1
6/28/2006	1025	SW-08		7.73	274	23.61	5.11	-38.5
6/28/2006	1130	SW-34	0.5	6.85	871	27.41	0.54	-196.3
6/28/2006	1155	SW-36	0.8 – 1.0	6.78	671	23.05	6.36	-134.6
6/29/2006	825	SW-36	0.8 – 1.0	6.77	578	21.85	1.36	-141.1
6/29/2006	920	SW-37	0.7 – 0.8	7.15	416	22.62	2.73	-139.9
6/30/2006	830	SW-13		7.78	669	20.62	3.39	53.6*
12/12/2006	853	SW -38	0.38	6.9	1.726	3	--	228.9
12/12/2006	1110	SW -38	--	7.17	1.77	4.64	137	163.3
12/12/2006	903	SW -39	0.5	6.6	1.95	5.2	--	209.7
12/12/2006	1115	SW-39	--	7	1.868	7.05	125.6	187.89
12/12/2006	912	SW-40	0.38	6.77	1.923	5.62	--	167.9
12/12/2006	1130	SW-40	--	5.58	2.093	8.28	120	177.9
12/12/2006	1343	SW-41	0.125	7	1.004	6.26	99.7	129.6
12/12/2006	1400	SW-42	0.25	7.04	0.826	11.04	91.6	148.3
12/12/2006	945	SW-43	0.67	7.7	0.903	7	--	151
12/12/2006	1440	SW-43		7.6	0.87	7.85	37.8	74.8
12/12/2006	954	SW-44	0.67	7.83	0.893	7.7	11.9	136.3
12/12/2006	845	SW-45	0.25	6.68	1.44	9.94	--	267.2
12/12/2006	1100	SW -45	--	--	--	--	84	--
7/18/2007	949	SW-38	0.7	7.15	1.318	26.27	10.12	54.4
7/18/2007	1007	SW-39	0.6	7.15	1.319	26.37	6.4	-346.9
7/18/2007	1024	SW-40	0.8	7.09	1.305	25.65	2.3	-266.5
7/18/2007	1136	SW-43	0.5	8.08	0.386	24.99	12.32	-40.7
7/18/2007	1154	SW-44	0.4	7.04	0.418	24.24	5.28	-4.03
7/19/2007	910	SW-41	1.2	7.09	1.305	25.65	2.3	-266.5
7/19/2007	1315	SW-TRC-3-S	0.4	6.73	0.876	27.65	1.18	-238.2
7/19/2007	1340	SW-52	0.5	7.97	0.57	30.61	10.71	-57.7

* ORP reading slowly decreased and never stabilized, value recorded after approximately 2 minutes.

Table 4-3
Summary of Bioassay Sediment Sample Locations

Bioassay Sample	Ditch / Waterbody	Location description	Associated Chemistry Sample
SD-CT-01	East Ditch #1	North end, west side.	SD-01
SD-CT-05	East Ditch #1	Confluence of East Ditch #2.	SD-05
SD-CT-06	East Ditch #1	Northwest side of the ditch, between the confluence with East Ditch #2 and Rose Creek.	SD-06
SD-CT-08	Rose Creek	West of the East Ditch #1 confluence.	SD-08
SD-CT-13	Rose Creek	Roughly 200 feet east-southeast of Collinsville Road	Approximately 200 feet up-gradient of SD-13
SD-CT-34	Old Cahokia Creek Watershed	Edge of open water northwest of West Ditch Outfall	SD-34
SD-CT-36	Schoenberger Creek	At western-most culvert outfall along north-east side of the Creek that receives drainage from the adjacent Old Cahokia Creek Watershed.	SD-36

TABLE 4-4
PHYSICAL APPEARANCE OF SEDIMENT COLLECED FOR BIOASSAYS
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS

SEDIMENT IDENTIFICATION	DRAINAGE WAY / AREA	DESCRIPTION
Laboratory control	--	Shredded brown paper toweling
BT-CT-01 (Field Control)	East Ditch #1	Dark clayey loam with decaying vegetation, no odor, no oily sheen, oligocahetes and three midges were removed.
BT-CT-05	East Ditch #1	Dark brownish clay with decaying vegetation, no odor or oily sheen, rust-iron layer, no macroinvertebrates were observed.
BT-CT-06	Rose Creek	Dark clayey loam with decaying vegetation, no odor or oily sheen, oligocahetes and two midges were removed.
BT-CT-08	Rose Creek	Black clayey silt with decaying vegetation, no odor or oily sheen, some oligochaetes were removed.
BT-CT-13	Rose Creek	Grayish clay silt, less vegetation, no odor or oily sheen, no macroinvertebrates were found.
BT-CT-34	West Ditch Outfall	Black clay with duck weed (Lemna sp.) and other vegetation, no odor or oily sheen, some oligochaetes were found.
BT-CT-036	Schoenberger Creek	Black clay with big pieces of twigs and some decaying vascular plant material, no odor or oily sheen, a few oligochaetes were removed.

From Attachment C, Whole Aquatic Sediment Evaluation Employing the Dipteran, Chironimus tetans

Table 4-5
Benthic Tissue Sample Composition
Former American Zinc Plant Site
Fairmont City, Illinois

Sample No.	Location	Family Name	Common Name	Trophic status
BT-SD-01	East Ditch 1 at origin	Aeschnidae	darner dragonflies	predator
BT-SD-05	East Ditch 1 at mouth of East Ditch 2	Physidae Coenagrionidae Aeschnidae Chironomidae	pond snails narrow-winged damselflies darner dragonflies nonbiting midges	scraper predator predator gatherer
BT-SD-06	East Ditch 1 downstream of East Ditch 2	Physidae Coenagrionidae Chironomidae	pond snails narrow-winged damselflies nonbiting midges	scraper predator gatherer
BT-SD-06 DUP	East Ditch 1 downstream of East Ditch 2	Physidae Coenagrionidae Chironomidae	pond snails narrow-winged damselflies nonbiting midges	scraper predator gatherer
BT-SD-08	Rose Creek at discharge of East Ditch 1	Aeschnidae Libellulidae	darner dragonflies skimmer dragonflies	predator predator
BT-SD-08 DUP	Rose Creek at discharge of East Ditch 1	Aeschnidae Libellulidae	darner dragonflies skimmer dragonflies	predator predator
BT-SD-13	Rose Creek upstream of Collinsville Road	Aeschnidae Calopterygidae	darner dragonflies broad-winged damselflies	predator predator
BT-SD-34	Shallow marsh discharge of West Ditch 1	Planorbidae	orb snails	scraper
BT-SD-22	Schoenberger Creek upstreram of Collinsville Road	Aeschnidae	darner dragonflies	predator
BT-SD-36	Schoenberger Creek at discharge of the Engineered Ditch	Physidae Coenagrionidae Aeschnidae Libellulidae	pond snails narrow-winged damselflies darner dragonflies skimmer dragonflies	scraper predator predator predator
BT-SD-37	Schoenberger Creek downstream of discharge of the Engineered Ditch	Aeschnidae	darner dragonflies	predator

TABLE 4-6
SUMMARY OF AQUATIC MACRO-INVERTEBRATE COMMUNITY SAMPLING LOCATIONS
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS

SAMPLE DESIGNATION	DRAINAGE WAY / AREA	SAMPLE DATE	APPROXIMATE SAMPLE TIME	NOTES [1]
BT-SD-01	East Ditch #1	June 27, 2006	1045 -1215	Sampled area extended from SD-SW-01 /SD-CT-01 south approximately 200 feet. Sample consist predominantly of dragonfly larva.
BT-SD-05	East Ditch #1	June 27, 2006	1430 - 1700	Sample area extended from SD-SW-05/SD-CT-05 south approximately 100 feet.
BT-SD-06	Rose Creek	June 28, 2006	0845 - 1040	Sampled area extended from SD-SW-06/SD-CT-06 northeast approximately 85 feet. Duplicate tissue sample collected.
BT-SD-08	Rose Creek	June 28, 2006	1115 - 1245	Sample area extended from SD-SW-08/SD-CT-08 northeast approximately 60 feet.
BT-SD-13	Rose Creek	June 29, 2006	0800 - 0930	Sampled area encompassed approximate 75 foot stretch of creek, roughly 200 feet east of sediment sample SD-13/SD-CT-13.
BT-SD-22	Schoenberger Creek	June 30, 2006	0730 - 0900	Sampled area encompassed approximate 160-foot stretch of creek south and north of SD-SW-022.
BT-SD-34	West Ditch Outfall	June 28, 2006	1500 - 1630	Along edge of open water in Old Cahokia Creek Watershed, downstream of outfall.
BT-SD-036	Schoenberger Creek	June 29, 2006	1130 -1300	Sampled area encompassed approximate 250 foot strecth of creek upstream and downstream of SD-SW-036.
BT-SD-037	Schoenberger Creek	June 29, 2006	1400 - 1530	Sampled area encompassed approximate 60 foot stretch of creek upstream and downstream of SD-SW-037.

1 - SD-00X and SW-00X reference the locations of sediment and/or surface water samples collected for chemical analyses.

Table 5-1

Concentrations of 8 RCRA Metals, Copper, Zinc (mg/Kg) and Detected Pesticide Compounds (ug/Kg) in Sediment Samples Compared to Ecological Screening Levels

Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID: / Date Collected / Depth (ft - ft) / Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-01-0.5 5/31/2006 0 - 0.5 East Ditch 1		SD-05-0.5 5/31/2006 0 - 0.5 East Ditch 1		SD-06-0.5 5/31/2006 0 - 0.5 East Ditch 1	SD-02-0.5 5/31/2006 0 - 0.5 East Ditch 2	SD-03-0.5 6/1/2006 0 - 0.5 Ditch along Kingshwy		SD-04-0.5 6/1/2006 0 - 0.5 Rose Creek (upstream)		SD-08-0.5 5/31/2006 0 - 0.5 Rose Creek (at-site)		SD-07-0.5 6/2/2006 0 - 0.5 West Ditch 2	SD-07-0.5/FD 6/2/2006 0 - 0.5 West Ditch 2		SD-09-0.5 5/30/2006 0 - 0.5 Rose Creek		SD-41 12/12/2006 0 - 0.5 Rose Creek	
Metals																				
Arsenic	9.79	17		130		8.5	9.3	10		6.7		29		98	45		60		94	
Barium	–	240		480		200	320	150		190		380		87	75		150		180	B
Cadmium	0.99	130		270		61	24	38		6.5		460		37	37		100		160	
Chromium	43.4	33		24		14	50	26		60		74		11	10		32		58	B
Copper	31.6	na		na		na	na	na		na		na		na	na		na		1,100	
Lead	35.8	870		3,300		100	440	520		280		1,700		2,200	1,800		1,800		4,100	
Selenium	–	4.5		5.4		1.7	1.9	0.97	B	3.3		5.5		1.6	0.92	B	3.4		5.9	
Silver	1	29		64		1.2	1.9	2.5		1.0		17		13	9.7		10		19	
Zinc	121	10,000		18,000		2,600	1,800	3,900		1,100		25,000		33,000	23,000		15,000		31,000	
Mercury	0.174	6.1		8.8		2.2	1.0	0.32		0.26		6.4		0.57	0.96		1.9		1.6	
Organics	(ug/Kg)																			
Aldrin	2	<60	U	96		na	na	<20	U	<38	U	<46	U	na	na		<21	U	na	
Dieldrin	1.9	<60	U	180		na	na	170		27	J	93		na	na		43		na	
4,4'-DDE	3	<60	U	<40	U	na	na	14	J	<38	U	<46	U	na	na		<21	U	na	
4,4'-DDT	4	<60	U	<40	U	na	na	43		<38	U	<46	U	na	na		14	J	na	
Endrin	2	<60	U	<40	U	na	na	53		<38	U	<46	U	na	na		<21	U	na	
gamma-Chlordane	3	<60	U	69		na	na	<20	U	<38	U	67		na	na		<21	U	na	

Sample ID / Date Collected. / Depth (ft - ft) / Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-41-D 12/12/2006 0 - 0.5 Rose Creek	SD-42 12/12/2006 0 - 0.5 Rose Creek	SD-10-0.5 6/12/2006 0 - 0.5 Rose Creek	SD-11-0.5 6/12/2006 0 - 0.5 Rose Creek	SD-12-0.5 6/12/2006 0 - 0.5 Rose Creek	SD-12/FD 6/12/2006 0.0 - 0.5' Rose Creek	SD-13-0.5 6/12/2006 0 - 0.5 Rose Creek	SD-43 12/12/2006 0 - 0.5 Rose Creek	SD-44 12/12/2006 0 - 0.5 Rose Creek	SD-14-0.5 6/12/2006 0 - 0.5 Rose Creek Outfall	SD-15-0.5 6/12/2006 0 - 0.5 Rose Creek Outfall
Mercury												
Arsenic	9.79	61	72	23	10	6.0	6.8	140	16	120	10	9.7
Barium	–	160 B	200 B	150	140	160	140	290	270 B	300 B	310	250
Cadmium	0.99	170	510	180	29	28	39	100	130	79	12	7.4
Chromium	43.4	27 B	33 B	24	33	23	29	31	71 B	31 B	23	21
Copper	31.6	780	950	na	na	na	na	na	*160*	*100*	na	na
Lead	35.8	2,600	2,700	860	300	120	190	680	580	750	430	230
Selenium	–	4.6	5.2	2.7	1.5	<1.4 U	<1.4 U	2.4 B	1.9	2.4	0.72 B	1.2 B
Silver	1	13	18	6.1	1.2	0.45 B	0.72	1.8	3.0	3.7	0.64 B	0.35 B
Zinc	121	24,000	1,200	13,000	4,800	2,300	3,400	9,200	7,300	5,300	1,100	740
Mercury	0.174	0.92	2.8	1.5	0.66	0.25	0.33	1.0	3.4	2.7	0.29	0.26
Organics	(ug/Kg)											
Aldrin	2	na	na	na	na	na	na	na	na	na	na	na
Dieldrin	1.9	na	na	na	na	na	na	na	na	na	na	na
4,4'-DDE	3	na	na	na	na	na	na	na	na	na	na	na
4,4'-DDT	4	na	na	na	na	na	na	na	na	na	na	na
Endrin	2	na	na	na	na	na	na	na	na	na	na	na
gamma-Chlordane	3	na	na	na	na	na	na	na	na	na	na	na

Sample ID / Date Collected / Depth (ft - ft) / Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-16-0.5 6/12/2006 0 - 0.5 Rose Creek Outfall	SD-17-0.5 6/12/2006 0 - 0.5 Rose Creek Outfall	SD-18-0.5 6/12/2006 0 - 0.5 Rose Creek Outfall	SD-20-0.5 6/13/2006 0 - 0.5 Sch. Creek	SD-20-0.5/FD 6/13/2006 0.0 - 0.5 Sch. Creek	SD-21-0.5 6/12/2006 0 - 0.5 Sch. Creek	SD-22-0.5 6/13/2006 0 - 0.5 Sch. Creek	SD-36 6/29/2006 0 - 0.5 Sch. Creek	SD-037 6/29/2006 0 - 0.5 Sch. Creek	SD-23-0.5 6/2/2006 0 - 0.5 West Ditch 1	SD-23-0.5/FD 6/2/2006 0 - 0.5 West Ditch 1
Metals												
Arsenic	9.79	8.2	20	9.5	12	12	13	12	13	15	78	81
Barium	–	220	120	250	510	480	510	640	270	340	270	290
Cadmium	0.99	1.1	15	26	23	23	27	21	19	44	130	120
Chromium	43.4	19	16	22	120	99	110	250	53	230	21	24
Copper	31.6	na	na	na	na	na	na	na	na	na	na	na
Lead	35.8	33	160	210	170	150	160	230	70	150	1,700	1,800
Selenium	–	<1.4 U	0.56 B	1.2 B	<2.5 U	1.9 B	<2.7 U	1.3 B	0.89 B	1.8 B	1.9	2.7
Silver	1	0.24 B	0.35 B	0.64 B	0.72 B	0.57 B	0.67 B	0.86 B	0.23 B	0.96 B	13	14
Zinc	121	140	1,700	810	1,000	930	980	940	750	1,100	14,000	15,000
Mercury	0.174	0.078	0.45	0.45	0.51	0.63	0.38	0.30	0.22	0.25	1.4	1.2
Organics	(ug/Kg)											
Aldrin	2	na	na	na	na	na	na	na	na	na	na	na
Dieldrin	1.9	na	na	na	na	na	na	na	na	na	na	na
4,4'-DDE	3	na	na	na	na	na	na	na	na	na	na	na
4,4'-DDT	4	na	na	na	na	na	na	na	na	na	na	na
Endrin	2	na	na	na	na	na	na	na	na	na	na	na
gamma-Chlordane	3	na	na	na	na	na	na	na	na	na	na	na

Notes:

BOLD values indicate the value exceeds the EPA Region V ESLs

B Compound found in blank and sample

J Compound detected at concentration below reporting limit but above the MDL and therfore is an approximate value

U or < Compound not detected above MDL

** Denotes background samples*

Sch Creek = Schoenberger Creek

[1] State background values per the Illinois Concentrations of Inorganic Chemicals in Background Soils - for MSA Counties (includes St Clair) per 35 IAC 742, Appendix A, Table G

[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed.

[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed

[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34).

Sch Creek = Schoenberger Creek

na not analyzed

V Serial dilution exceeds the limits

** ICV, CCV, ICB, CCB, ISA, ISB, CRI, CRA or MRL standard- Instrument related to QC exceeds the control limits*

Table 5-1 continued

Concentrations of 8 RCRA Metals, Copper, Zinc (mg/Kg) and Detected Pesticide Compounds (ug/Kg) in Sediment Samples Compared to Ecological Screening Levels

Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-24-0.5 6/1/2006 0 - 0.5 West Ditch 1		SD-25-0 5 6/1/2006 0 - 0.5 West Ditch 1		SD-25-0.5/FD 6/1/2006 0 - 0.5 West Ditch 1	SD-26-0.5 6/1/2006 0 - 0.5 West Ditch 1	SD-27-0.5 6/1/2006 0 - 0.5 West Ditch 1	SD-28-0.5 6/1/2006 0 - 0.5 West Ditch 1		SD-29-0.5 6/1/2006 0 - 0.5 West Ditch 1 Outfall		SD-30-0 5 6/1/2006 0 - 0.5 West Ditch 1 Outfall		SD-31-0.5 6/1/2006 0 - 0.5 West Ditch 1 Outfall	SD-32-0.5 6/1/2006 0 - 0.5 West Ditch 1 Outfall	SD-33-0.5 6/1/2006 0 - 0.5 West Ditch 1 Outfall
Metals																	
Arsenic	**9.79**	**130**		9.3		**60**	**24**	**29**	**27**		**11**		**13**		8 0	**25**	5
Barium	–	610		120		480	230	400	200		190		180		220	270	140
Cadmium	**0.99**	**630**		**27**		**650**	**64**	**61**	**51**		**43**		**72**		**32**	**69**	**6.6**
Chromium	**43.4**	**61**		17		**69**	19	15	16		15		17		14	22	9.6
Copper	**31.6**	na		na		na	na	na	na		na		na		na	na	na
Lead	**35.8**	**5,600**		**3,300**		**3,000**	**810**	**980**	**730**		**380**		**510**		**52**	**870**	**46**
Selenium	–	7.2		2 1	B	7 8	1 3	1 8	1 1	B	0 83	B	0 95	B	0 89 B	1 3	<1 0 U
Silver	**1**	*33*		3 6		**40**	***3.8***	***3.2***	***5.1***		***1.4***		***1.8***		0.24 B	**4**	<0 50 U
Zinc	**121**	**40,000**		**6,800**		**95,000**	**21,000**	**20,000**	**15,000**		**4,000**		**3,800**		**7,900**	**6,400**	**590**
Mercury	**0.174**	***0.83***		0 17		**6.3**	***0.24***	**0.16**	***0.33***		0.11		0 14		0 042	**0.19**	0 034
Oranganics	(ug/Kg)																
Aldrin	**2**	<30	U	na		na	na	na	na		na		na		na	na	na
Dieldrin	**1.9**	41		na		na	na	na	na		na		na		na	na	na
4,4"-DDE	**3**	<30	U	na		na	na	na	na		na		na		na	na	na
4,4'-DDT	**4**	<30	U	na		na	na	na	na		na		na		na	na	na
Endrin	**2**	<30	U	na		na	na	na	na		na		na		na	na	na
gamma-Chlordane	**3**	<30	U	na		na	na	na	na		na				na	na	na

Sample ID. Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-034 6/28/2006 0 - 0.5 Cahokia Watershed [3]	SD-034-D 6/28/2006 0 - 0.5 Cahokia Watershed [3]	SD-38 12/12/2006 0 - 0 5 Cahokia Watershed [4]	SD-39 12/12/2006 0 - 0.5 Cahokia Watershed [4]	SD-40 12/12/2006 0 - 0.5 Cahokia Watershed [4]	SD-45 12/12/2006 0 - 0.5 Cahokia Wetland [2]	SD-46 12/13/2006 0 - 0 5 Cahokia Wetland [2]	SD-47 12/13/2006 0 - 0.5 Cahokia Wetland [2]	SD-48 12/13/2006 0 - 0.5 Cahokia Wetland [2]
Arsenic	**9.79**	**15**	**17**	**15**	**20**	**11**	**15**	**19**	**19**	**25**
Barium	–	210	230	220 B	120 B	140 B	210 B	250 B	220 B	210 B
Cadmium	**0.99**	**300**	**380**	**140**	**25**	**99**	**56**	**150**	**90**	**89**
Chromium	**43 4**	17	21	21 B	15 B	14 B	19 B	21 B	17 B	21 B
Copper	**31.6**	na	na	**1,100**	**260**	**320**	**1,800**	**4,200**	**3,400**	**5,300**
Lead	**35.8**	**440**	**550**	**340**	**240**	**190**	**220**	**590**	**420**	**670**
Selenium	–	<3 7 U	2 5 B	<9 7	<9 7	<9 3	1 1 J	1 8	1 4	1 9
Silver	**1**	**3.0**	**3.4**	**3.0 J**	**2.1 J**	**1.1 J**	**1.2**	**3.6**	**2.2**	**4.6**
Zinc	**121**	**35,000**	**43,000**	**14,000**	**3,500**	**8,900**	**16,000**	**23,000**	**25,000**	**26,000**
Mercury	**0.174**	**0.31**	**0.18**	**0.27**	<0 21	0.085	0 11	**0.32**	**0.19**	**0.36**

Sample ID Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	TWD-1-N-0-6 7/17/2007 0 - 0 5 (0-6") Old Cahokia Watershed [5]	TWD-1-N-6-8 7/17/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [5]	TWD-1-C-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-1-C-6-10 7/17/2007 0.5 - 0.8 (6-10") Old Cahokia Watershed [5]	TWD-1-S-0-6 7/17/2007 0 - 0 5 (0-6") Old Cahokia Watershed [5]	TWD-1-S-6-9.5 7/17/2007 0.5 - 0 75 (6-9.5") Old Cahokia Watershed [5]	TWD-02-N-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-02-N-6-7 7/17/2007 0 5 - 0.6 (6-7") Old Cahokia Watershed [5]	TWD-02-C-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-02-C-6-9 7/17/2007 0 5 - 0.75 (6-9") Old Cahokia Watershed [5]	TWD-02-C-6-9 DUP 7/17/2007 0 5 - 0.75 (6-9") Old Cahokia Watershed [5]
Arsenic	**9.79**	7 7	5 8	**16**	8 5	7 1	**11**	**10**	7	**15**	5 4	4 6
Barium	–	250	250	230	260	420	450	250	240	200	310	280
Cadmium	**0 99**	**55**	**4.1**	**44**	**16**	**90**	**15**	**32 V**	**44 V**	**71 V**	**17 V**	**12 V**
Chromium	**43 4**	29 B	31 B	33 B	30 B	30 B	29 B	32 ^V	29 ^V	28 ^V	32 ^V	33 ^V
Copper	**31 6**	**61 B**	**32 B**	**53 B**	**34 B**	**130 B**	**47 B**	**61**	**57 B**	**340 B**	**66 B**	**61 B**
Iron	–	30,000	na	31 000	na	29,000		30,000 v	na	23,000 V	na	na
Lead	**35.8**	**140**	32	**78**	33	**390**	**78**	**140**	**130**	**210**	**160**	**120**
Manganese	–	710	na	580	na	540		650 v	na	690 V	na	na
Selenium	–	1.5 J	1 4 J	1 6 J	1 2 J	2 J	1 3 J	1 J	1 J	<3 6	<1 4	1 1 J
Silver	**1**	0 58 J	0 3 J	0 35 J	0 24 J	**1.5**	0 41 J	0 48 J	0 43 J	1 J	0 56 J	0 37 J
Zinc	**121**	**2,000 B**	**350 B**	**2,900**	**1,800 B**	**4,600 B**	**1,800 B**	**1800 B**	**1800 B**	**12,000 B**	**1,900**	**1,900**
Mercury	**0.174**	0.070	0 06	0 076	0 068	**0.2**	0 076	0 073	0 08	0.15	0 079	0 087

Notes:

BOLD values indicate the value exceeds the EPA Region V ESLs

na not analyzed

B. Compound found in blank and sample

J- Compound detected at concentration below reporting limit but above the MDL and therfore is an approximate value.

U or < Compound not detected above MDL

** Denotes background samples*

Sch Creek = Schoenberger Creek

[1] State background values per the Illinois Concentrations of Inroganic Chemicals in Background Soils - for MSA Counties (includes St. Clair) per 35 IAC 742, Appendix A, Table G

[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed

[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed

[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34)

[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area

[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area.

V Serial dilution exceeds the limits

^ ICV CCV, ICB, CCB, ISA, ISB, CRI, CRA or MRL standard Instrument related to QC exceeds the control limits

Table 5-1 continued

Concentrations of 8 RCRA Metals, Copper, Zinc (mg/Kg) and Detected Pesticide Compounds (ug/Kg) in Sediment Samples Compared to Ecological Screening Levels

Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	TWD-02-S-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-02-S-6-8 7/17/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [5]	TWD-03-N-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-03-N-6-8 7/17/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [5]	TWD-03-C-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-03-C-6-8.5 7/17/2007 0.5 - 0.66 (6-8.5") Old Cahokia Watershed [5]	TWD-03-S-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	TWD-03-S-6-8 7/17/2007 0.5 - 0.6 (6-8") Old Cahokia Watershed [5]	TWD-03-S-10-12 7/17/2007 0.83 - 1.0 (10-12") Old Cahokia Watershed [5]	TRC-1-N-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-1-N-6-8 7/18/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]
Arsenic	9.79	5 9	7 8	7.7	7 1	7 3	6 1	10	6.2	4 4	5 6	5 3
Barium	—	320	460	230	220	270	310	210	320	280	330	290
Cadmium	0 99	140 V	34 V	28 V	18 V	25 V	21 V	23 V	20 V	19 V	13	4.1
Chromium	43.4	31 ^V	32 ^V	30 ^V	28 ^V	29 ^V	28 ^V	20 ^V	29 ^V	29 ^V	24	22
Copper	31.6	790 B	91 B	51 B	35 B	75 B	59 B	79 B	42 B	41 B	37 B	28 B
Iron	—	27,000 V	na	27,000 V	na	26,000 V	na	18,000 V	na	na	25,000	na
Lead	35.8	260	210	130	52	180	140	150	59	48	38 B	21 B
Manganese	—	570 V	na	750 V	na	740 V	na	330 V	na	na	480	na
Selenium	—	<2.1	<1 5	1 J	1 6	2 J	0 69 J	1 6 J	1 2 J	0 84 J	1 3 J	1 2 J
Silver	1	1.2	0 52 J	0 49 J	0 16 J	0 62 J	0 5 J	0 78 J	<0 74	<0 75	<0 96	<0 81
Zinc	121	16,000	3,700 B	1,900 B	1,200 B	2,700	1,300 B	2,400 B	1,300 B	1,300 B	680 V,B	440
Mercury	0.174	0 13	0 095	0.063	0 055	0.11	0 067	0 1	0 072	0 067	0 11	0 052

Sample ID Date Collected. Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	TRC-1-S-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-1-S-0-6-D 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-1-S-6-8 7/19/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	TRC-2-N-0-6 7/18/2007 Old Cahokia Watershed [6]	TRC-2-N1-0-6 7/17/2007 Old Cahokia Watershed [6]	TRC-2-N1-6-8 7/18/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	TRC-2-C-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-2-C-10-12 7/18/2007 0.83 - 1.0 (10-12") Old Cahokia Watershed [6]	TRC-2-S-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-2-S-8-10 7/18/2007 0.66 - 0.83 (8-10") Old Cahokia Watershed [6]	TRC-2-S-12-14 7/18/2007 1.0 - 1.16 (12-14") Old Cahokia Watershed [6]
Arsenic	9.79	19	19	6 1	2 3	6 9	18	5 6	3 7	160	360	570
Barium	—	270	340	290	160	170	180	310	250	400	490	660
Cadmium	0.99	8.1	7.4	7.4	<0 22	<0 25	<0 29	4.8	0 26 J	1,300 V	2,100 V	140 V
Chromium	43 4	26	26	22	8 3	14	15	23	18	63	80	110
Copper	31.6	36 B	35 B	25 B	6 4 B	16 B	15 B	31 B	22 B	430 B	520 B	2,500 B
Iron	—	29,000	27,000	na	8,900	17 000	na	25,000	na	57,000 V	na	
Lead	35 8	75 B	72 B	17 B	9 B	11 B	12 B	33 B	16 B	1,600	2,100	5,500
Manganese	—	470	380	na	120	620	na	560	na	280 V	na	
Selenium	—	1 6 J	1 3 J	1 3 J	<1 1	0 6 J	1 1 J	1 8 J	0 85 J	10 B	12	25
Silver	1	<0.88	<0 84	<0 83	<0 56	<0 64	<0 72	0 22 J	<0 67	12	15	55
Zinc	121	740	740	700 B,V	38 B,V	53 B,V	54 ,V	240 B	79 V B	15,000	20,000	6,600
Mercury	0 174	0 14	0.19	0 034	0 02 J	0 033	0 03	0 051	0 042	11	14	120

Sample ID Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	TRC-2-S1-0-6 7/19/2007 0 - 0 5 (0-6") Old Cahokia Watershed [4]	TRC-3-N-0-6 7/18/2007 0 - 0 5 (0-6") Old Cahokia Watershed [6]	TRC-3-N-0-6/FD 7/18/2007 0.5 - 0 66 (6-8") Old Cahokia Watershed [6]	TRC-3-N-8-10 7/19/2007 0 - 0 5 (0-6") Old Cahokia Watershed [6]	TRC-3-S-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	TRC-3-S-7-9 7/18/2007 0.58-0.75 (7-9") Old Cahokia Watershed [6]	SD-50-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Creek	SD-50-8-10 7/19/2007 0.66 - 0.83 (8-10") Old Cahokia Creek	SD-51-DITCH-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	SD-51-DITCH-8-10 7/19/2007 0.66 - 0.83 (8-10") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	SD-51-DITCH-12-14 7/19/2007 1 0 - 1 16 (12-14") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill
Arsenic	9.79	61	1 6	1 9	2	12	4 6	4 4	9 4	75	110	79
Barium	—	320	74	120	49	300	250	220	250	400	290	520
Cadmium	0.99	290	0 48	0 1 J	<0 25	36 V	64 V	22	22	100	330	75
Chromium	43 4	48	6	8 3	4 6	43	26	18	20	49	110	59
Copper	31.6	460 B	6 B	7 2 B	2.8 B	230 B	170 B	29 B	41 B	98 B	160 B	600 B
Iron	—	30,000	6,500	9,200	na	29,000.0 V	na	20,000	na	37,000	na	na
Lead	35.8	1,200 B	7 1 B	9 B	4 2 B	79	38	58 B	92 B	300 B	650 B	1,600 B
Manganese	—	550	74	100	na	420 V	na	530	na	330	na	na
Selenium	—	5.6	<1 4	<1 3	<1 2	1 4 J	<1 7	1 1 J	1 9	3 5	4 1	14
Silver	1	12	<0 68	<0.64	<0 62	0 29 J	<0 86	<0 67	0 18 J	2.2	3.6	25
Zinc	121	8,600	42	47 B,V	19 B,V	1,100 B	1,600 B	780	1100 B,V	1,900 B,	3100 B,V	1,600 B,V
Mercury	0.174	3.4	0 014 J	0 0091 J	0 0068	0.18	0 073	0 13	0 077	2	5.3	18

Notes:

BOLD values indicate the value exceeds the EPA Region V ESLs

na not analyzed

B Compound found in blank and sample

J Compound detected at concntration below reporting limit but above the MDL and therfore is an approximate value

U or <: Compound not detected above MDL

** Denotes background samples*

Sch Creek = Schoenberger Creek

[1] State background values per the Illinois Concentrations of Inroganic Chemicals in Background Soils - for MSA Counties (includes St Clair) per 35 IAC 742. Appendix A, Table G

[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed

[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.

[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34)

[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area

[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area

V Serial dilution exceeds the limits

^- ICV, CCV, ICB, CCB, ISA, ISB, CRI, CRA or MRL standard Instrument related to QC exceeds the conrol limits

Table 5-1 continued
Concentrations of 8 RCRA Metals, Copper, Zinc (mg/Kg) and Detected Pesticide Compounds (ug/Kg) in Sediment Samples Compared to Ecological Screening Levels
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID: Date Collected Depth (ft - ft) Location	USEPA Region V Ecological Screening Levels (ESLs) (mg/Kg)	SD-52 7/19/2007 0 - 0.5 (0-6") Schoenberger Creek - west of Old Cahokia western boundary	RSD-1 7/17/2007 0-0.5 (0-6") Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	RSD-2 7/17/2007 0-0.5 (0-6") Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	RSD-3 7/17/2007 0-0.5 (0-6") Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	RSD-4 7/17/2007 0-0.5 (0-6") Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem
Arsenic	9.79	26	16	21	4.9	23
Barium	–	260	240	320	120	380
Cadmium	0.99	80 V	4.9	9.9	5	9.9
Chromium	43.4	630	53 B	59 B	90 B	91 B
Copper	31.6	75 B	210 B	250 B	140 B	340 B
Lead	35.8	180	620	780	380	630
Selenium	–	1.7 J	2.7	2.1	0.73 J	2.3
Silver	1	1.1	2.1	2.3	2.4	2.9
Zinc	121	1,800 B	710	1300	820 B	1600 B
Mercury	0.174	0.15	5.3	4.1	0.0068	4.1

Notes:

BOLD values indicate the value exceeds the EPA Region V ESLs

na: not analyzed

B Compound found in blank and sample

J Compound detected at concntration below reporting limit but above the MDL and therfore is an approximate value

U or <: Compound not detected above MDL

** Denotes background samples*

Sch Creek = Schoenberger Creek

[1]: State background values per the Illinois Concentrations of Inroganic Chemicals in Background Soils - for MSA Countres (includes St Clair) per 35 IAC 742, Appendix A, Table G

[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed

[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.

[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34)

[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area

[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area

V Serial dilution exceeds the limits

^ ICV, CCV, ICB CCB, ISA, ISB, CRI, CRA or MRL standard Instrument related to QC exceeds the conrol limits

Table 5-2
Concentrations of Total and Dissolved Metals (mg/L) and Detected Organic Compounds (ug/L) in Surface Water Samples Compared to Ecological Screening Levels
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID: / Date Collected: / Location	EPA Region V Ecological Screening Criteria [1] (mg/L)	SW-01 5/31/2006 East Ditch 1	SW-05 5/31/2006 East Ditch 1	SW-06 5/31/2006 East Ditch 1	SW-07 6/2/2006 West Ditch 2	SW-07-FD 6/2/2006 West Ditch 2	SW-08 5/31/2006 Rose Creek	SW-10 6/12/2006 Rose Creek	SW-11 6/12/2006 Rose Creek	SW-12 6/12/2006 Rose Creek	SW-12/FD 6/12/2006 Rose Creek	SW-13 6/12/2006 Rose Creek
Total Arsenic	**0.148 (f)**	0.022	<0.010 U	<0.010 U	0 0030 B	<0.010 U	<0.010 U	0.012	0.0055 B	0.0046 B	<0.010 U	<0.010 U
Total Barium	**0.22 (i,j,k)**	**0.39**	0.011	0.02	0.089	0.090	0.067	0.094	0.054	0.10	0.086	0.071
Total Cadmium	**0 00015 (i,j,k)**	**0.094**	**0.0027**	**0.0086**	**0.18**	**0.18**	**0.055**	**0.064**	**0.0059**	**0.0036**	**0.0024**	**0.0040**
Total Chromium	**0.042 (j,k)**	0.019	<0 010 U	0 0014 B	<0 010 U	<0.010 U	0.0037 B	0.0064 B	0.0024 B	0.0056 B	0.0040 B	0.0017 B
Total Copper	**0.00158 (j, k, z)**	na	na	na	na	na	na	na	na	na	na	na
Total Lead	**0.00117 (j,k,z)**	**0.27**	**0.0076**	**0.043**	**0.25**	**0.21**	**0.20**	**0.16**	**0.013**	**0.050**	**0.029**	**0.0033** B
Total Selenium	**0.005 (j)**	<0 010 U	<0.010 U	<0.010 U	<0 010 U	<0 010 U	<0 010 U	<0 010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U
Total Silver	**0.00012 (f,z)**	**0.0046** B	<0.0050 U	<0 0050 U	<0.0050 U	<0 0050 U	<0.0050 U	**0.0012** B	<0.0050 U	<0.0050 U	<0.0050 U	<0 0050 U
Total Zinc	**0.0657 (j,k,z)**	**5.5**	**0.28**	**0.47**	**41**	**42**	**3.1**	**6.1**	**0.65**	**0.60**	**0.38**	**0.38**
Total Mercury	**0.0000013 (a)**	**0.0013**	<0.00020 U	0.00027	<0.00020 U	<0 00020 U	0.00067	**0.00017** B	<0.00020 U	<0.00020 U	<0 00020 U	<0.00020 U
Dissolved Arsenic	**0.148 (f)**	0.0074 B	<0.010 U	<0.010 U	<0.010 U	<0.010 U	0.0022 B	0.0078 B	0.0045 B	0 0028 B	0.0029 B	<0.010 U
Dissolved Barium	**0.22 (i,j,k)**	0 078	0.0061 B	0 0060 B	0 086	0 086	0.012	0 034	0.044	0.060	0 060	0.060
Dissolved Cadmium	**0.00015 (i,j,k)**	<0.0020 U	<0.002 U	<0 0020 U	**0.18**	**0.17**	<0 0020 U	**0.014**	**0.0040**	**0.00056** B	**0.00060** B	**0.00087** B
Dissolved Chromium	**0.042 (j,k)**	<0 010 U	<0.010 U	<0.010 U	<0 010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0 010 U	<0 010 U
Dissolved Copper	**0.00158 (j, k, z)**	na	na	na	na	na	na	na	na	na	na	na
Dissolved Lead	**0.00117 (j,k,z)**	**0.0028** B	<0.0050 U	**0.0035** B	**0.041**	**0.038**	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0 0050 U
Dissolved Selenium	**0.005 (j)**	<0.010 U	<0.010 U	<0 010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0 010 U	<0 010 U	<0 010 U
Dissolved Silver	**0.00012 (f,z)**	<0 0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U
Dissolved Zinc	**0.0657 (j,k,z)**	0.021	0.037	0 0089 B	**36**	**35**	0.015 B	**1.6**	**0.46**	**0.098**	**0.090**	**0.27**
Dissolved Mercury	**0.0000013 (a)**	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0 00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0 00020 U
Hardness, as $CaCO_3$		85 [2]	100 [2]	na	na	na	na	110 [2]	na	na	na	na

Sample ID: / Date Collected: / Location	EPA Region V Ecological Screening Criteria [1] (mg/L)	SW-17 6/12/2006 Rose Creek Outfall	SW-41 12/12/2006 Rose Creek	SW-41 Resample 7/19/2007 Rose Creek	SW-41-D 12/12/2006 Rose Creek	SW-41 D Resample 7/19/2007 Rose Creek	SW-42 12/12/2006 Rose Creek	SW-42 Resample 7/18/2007 Rose Creek	SW-43 12/12/2006 Rose Creek	SW-43 Resample 7/18/2007 Rose Creek	SW-44 12/12/2006 Rose Creek	SW-44 Resample 7/18/2007 Rose Creek
Total Arsenic	**0.148 (f)**	<0 010 U	<0 010	0.012	<0.010	0.0078 J	<0.010	No Water in creek at this location	<0.010	<0.010	<0.010	0.021
Total Barium	**0.22 (i,j,k)**	0.078	0 045	0.051	0.050	0.049	0 056		0.063	0.041	0.072	0.045
Total Cadmium	**0.00015 (i,j,k)**	**0.0090**	**0.21**	0.051	**0.18**	**0.04**	**0.19**		**0.0079**	<0.0020	**0.011**	0.0037
Total Chromium	**0 042 (j,k)**	0.0033 B	0.0016 J	<0.010	0.0022 J	<0 010	0.0024 J		0 0048 J	<0.010	0.0042 J	<0.010
Total Copper	**0.00158 (j, k, z)**	na	**0.016**	0 019	**0.017**	**0.017**	**0.017**		**0.022**	0.0039 J	**0.02**	0 0053 J
Total Lead	**0.00117 (j,k,z)**	**0.023**	**0.012**	**0.011**	**0.014**	**0.01**	**0.015**		**0.017**	0.0024 J	**0.018**	<0.0050
Total Selenium	**0.005 (j)**	<0.010 U	0.0050 J	<0.010	<0.010	<0.010	0.0045 J		<0.010	<0 010	<0 010	<0.010
Total Silver	**0 00012 (f,z)**	<0.0050 U	<0.0050	0.0021 J,B	<0.0050	0 0022 J,B	<0.0050		<0 0050	0 0015 J,B	<0.0050	0 0017 J,B
Total Zinc	**0.0657 (j,k,z)**	**0.79**	**32**	**11** B	**27**	**6.3** B	**23**		**1.1**	**0.15** B	**1.6**	**0.56** B
Total Mercury	**0 0000013 (a)**	**0.000098** B	<0 00020	<0.00020	<0.00020	<0.00020	<0.00020		<0.00020	<0 00020	<0.00020	<0 00020
Dissolved Arsenic	**0.148 (f)**	0 0053 B		<0.010		<0.010				0.0036 J		0.019
Dissolved Barium	**0.22 (i,j,k)**	0.060		0.044		0.054				0 031		0.04
Dissolved Cadmium	**0.00015 (i,j,k)**	**0.00056** B		0.03		**0.0310**				<0.0020		**0.001** J
Dissolved Chromium	**0.042 (j,k)**	<0.010 U		<0.010		0.0017 J				<0.010		0.0023 J
Dissolved Copper	**0.00158 (j, k, z)**	na		0.0075 J		**0.0088** J				0.0035 J		0.0032 J
Dissolved Lead	**0.00117 (j,k,z)**	<0.0050 U		<0.0050		<0.0050				<0.0050		<0 0050
Dissolved Selenium	**0.005 (j)**	<0 010 U		<0.010		<0.010				<0.010		<0.010
Dissolved Silver	**0.00012 (f,z)**	<0.0050 U		<0.0050		0.0012 J,B				**0.0025** J,B		**0.002** J,B
Dissolved Zinc	**0.0657 (j,k,z)**	**0.27**		**4.2** B		**4.2** B				0.035 B		**0.5** B
Dissolved Mercury	**0.0000013 (a)**	<0.00020 U		<0.00020		<0.00020				<0.00020		<0 00020
Hardness, as $CaCO_3$		na		na						na		na

NOTES:
Boldvalues indicate exceedences of generic EPA Region V Ecological Screening criteria
B. Compound found in blank and sample
U or <: Compound not detected above MDL
J Compound detected at concntration below reporting limit
Sch Creek = Schoenberger Creek
[1]. U.S EPA Region V, RCRA Ecological Screening Levels August 22, 2003
a derived from Michigan water quality standards, Rule 57 water quality values

f. derived from Minnesota water quality standards Rule 7050.0100, Subpart 2 (water ESL data for arsenic and benzene represents aquatic life chronic standards and dioxin, DDT, mercury and PCBs represent wildlife values) April 13, 2000 Rule 7050 0222 Subpart 2.
j. USEPA national recommended water quality criteria: 2002 (EPA 822-R-02-047)
k for hardness dependant metals (Cd, Cr^{+3}, Cu, Pb, Zn) freshwater chronic criteria are based on a default total hardness value of 50 mg/L as CaCO3 This surface water ESL has been recalculated using measured site specific hardness values
z New ESL is lower than the previous table
[2] Samples for analysys of hardness were collected on June 29, 2006.

Table 5-2 continued
Concentrations of Total and Dissolved Metals (mg/L) and Detected Organic Compounds (ug/L) in Surface Water Samples Compared to Ecological Screening Levels
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID:	EPA Region V Ecological Screening Criteria [1] (mg/L)	SW-24	SW-20	SW-20/FD	SW-21	SW-22	SW-36	SW-37	SW-34	SW-34-D	SW-38	SW-38 Resample
Date Collected:		6/1/2006	6/13/2006	6/13/2006	6/12/2006	6/13/2006	6/29/2006	6/29/2006	6/28/2006	6/28/2006	12/12/2006	7/18/2007
Location		West Ditch 1	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Cahokia Watershed [4]	Cahokia Watershed [4]	Reference [5]	Reference [5]
Total Arsenic	0.148 (f)	0.0065 B	<0.010 U	<0.010 U	0.020	<0.010 U	0.0057 B	0.0048 B	0.046	0 074	<0.010	0.01
Total Barium	0.22 (i,j,k)	0.046	0 10	0.11	**0.80**	0.10	0.17	0.15	**0.69**	**1.1**	0 055	0.11
Total Cadmium	0.00015 (i,j,k)	**0.012**	<0.0020 U	<0.0020 U	**0.043**	<0.0020 U	**0.00069** B	**0.00091** B	**1.3**	**2.2**	**0.27**	**0.038**
Total Chromium	0.042 (j,k)	<0.010 U	0 0020 B	0.0025 B	**0.17**	0.0033 B	0.0035 B	0.0061 B	**0.059**	**0.10**	0 0022 J	0.0034 J
Total Copper	0.00158 (j, k, z)	na	na	na	na	na	na	na	na	na	**0.033**	**0.140**
Total Lead	0.00117 (j,k,z)	**0.0094**	<0.0050 U	**0.0032** B	**0.23**	**0.0052**	**0.0078**	**0.0094**	**1.4**	**2.4**	<0.0050	0.022
Total Selenium	0.005 (j)	<0.010 U	<0 010 U	<0.010 U	<0.010 U	<0 010 U	<0.010 U	<0 010 U	**0.0087** B	**0.012**	<0.010	<0.010
Total Silver	0.00012 (f,z)	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0 0050 U	**0.011**	**0.017**	<0.0050	0.0029 J,B
Total Zinc	0.0657 (j,k,z)	**24**	0.013 B	0 024	**1.6**	0.021	0.045	0.051	**160**	**250**	**51**	**5.3** B
Total Mercury	0.0000013 (a)	<0 00020 U	<0.00020 U	<0 00020 U	**0.00079**	<0.00020 U	**0.00011** B	<0.00020 U	**0.00058**	**0.00045**	<0.00020	<0.00020
Dissolved Arsenic	0.148 (f)	0.0023 B	0.0042 B	0.0056 B	0.0042 B	<0.010 U	<0.010 U	<0.010 U	0.0030 B	<0.010 U		0.0034 J
Dissolved Barium	0.22 (i,j,k)	0.044	0.082	0.081	0.13	0.082	0.14	0.11	0.072	0.082		0.042
Dissolved Cadmium	0.00015 (i,j,k)	**0.0074**	<0.0020 U	<0.0020 U	<0.0020 U	<0 0020 U	<0.0020 U	<0.0020 U	<0.0020 U	<0 0020 U		<0.0020
Dissolved Chromium	0.042 (j,k)	<0 010 U	<0.010 U	<0 010 U	<0 010 U	<0.010 U	0.0017 B	0.0013 B	0.0019 B	<0 010 U		0.0033 J
Dissolved Copper	0 00158 (j, k, z)	na	na	na	na	na	na	na	na	na		0.003 J
Dissolved Lead	0.00117 (j,k,z)	**0.0039** B	<0 0050 U	<0.0050 U	<0.0050 U	<0 0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0 0050 U		<0.0050
Dissolved Selenium	0.005 (j)	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	**0.0078** B	<0.010 U	0.0049 B	0.0047 B		<0.010
Dissolved Silver	*0.00012 (f,z)*	*<0.0050 U*	*<0 0050 U*	*<0.0050 U*	*<0 0050 U*	*<0.0050 U*	*<0 0050 U*	*<0.0050 U*	*<0.0050 U*	*<0.0050 U*		*0 0029 J,B*
Dissolved Zinc	0 0657 (j,k,z)	**19**	0.0078 B	<0.020 U	0.0079 B	0.012 B	0.012 B	0.0067 B	0.057	0.063		0.079 B
Dissolved Mercury	0.0000013 (a)	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	**0.00013** B	<0 00020 U	<0.00020 U	<0.00020 U	<0.00020 U		<0 00020
Hardness, as $CaCO_3$		na	na	na	na	na	220	170	590	720	na	na

Sample ID:	EPA Region V Ecological Screening Criteria [1] (mg/L)	SW-39	SW-39 Resample	SW-40	SW-40 Resample	SW-45	SW-45 Resample	SW-50	SW-52	SW-TRC-3-S
Date Collected:		12/12/2006	7/18/2007	12/12/2006	7/18/2007	12/12/2006	7/18/2007	12/12/2006	12/12/2006	7/19/2007
Location		Reference [5]	Reference [5] - 40 feet east of SW-38	Reference [5]	Reference [5] - 75 feet east of SW-38	Cahokia Wetland [3] - south of open water shoreline	Cahokia Wetland [3] - south of open water edge	Cahokia Watershed - Upgradient of Rose Creek Discharge Area	Schoenberger Creek - west of Old Cahokia Watershed	West end of Old Cahokia Watershed, adjacent to Schoenberger Creek channel
Total Arsenic	0.148 (f)	<0 010	<0.010	<0.010	<0.010	<0.010	No Water in discharge channel at this location	0 0059	0 0039 J	0.018
Total Barium	0.22 (i,j,k)	0 048	0 063	0 053	0 14	0.043		0.045	0 15	**0.29**
Total Cadmium	0.00015 (i,j,k)	**0.17**	<0.0020	**0.20**	**0.006**	**0.99**		<0.0020	<0.0020	**0.034**
Total Chromium	0 042 (j,k)	0 0014 J	<0.010	0.0018 J	0.0019 J	0.0027 J		<0 010	0.0052 J	0.01
Total Copper	0 00158 (j, k, z)	**0.030**	0 008 J	**0.025**	0.0072 J	**2.0**		0 0018 J	0.0038 J	*0 042*
Total Lead	0.00117 (j,k,z)	<0.0050	<0.0050	<0.0050	<0.0050	**0.0070**		**0.0022** J	**0.0057**	**0.074**
Total Selenium	0.005 (j)	<0.010	<0 010	<0.010	<0.010	<0.010		<0 010	<0.010	<0.010
Total Silver	0.00012 (f,z)	<0.0050	0.0014 J,B	**0.0016** J	0.0025 J,B	**0.0018** J		<0.0050	0.0019 J,B	0.0012 J,B
Total Zinc	0.0657 (j,k,z)	**47**	0.25 B	**47**	**2.6** B	**260**		0 02 J,B	0.035 B	**1.3** B
Total Mercury	0.0000013 (a)	<0 00020		<0.00020	<0.00020	<0 00020		<0 00020	<0 00020	0.00036
Dissolved Arsenic	0.148 (f)		<0.010		<0.010			<0.010	<0.010	<0.010
Dissolved Barium	0.22 (i,j,k)		0.053		0.065			0.036	0 032	0.11
Dissolved Cadmium	0.00015 (i,j,k)		<0.0020		<0.0020			<0 0020	<0.0020	<0.0020
Dissolved Chromium	0 042 (j,k)		<0.010		<0.010			<0 010	<0.010	<0.010
Dissolved Copper	0.00158 (j, k, z)		<0.010		<0.010			<0 010	<0 010	<0.010
Dissolved Lead	0.00117 (j,k,z)		<0.0050		<0 0050			<0.0050	<0.0050	<0.0050
Dissolved Selenium	0.005 (j)		<0.010		<0 010			<0 010	<0.010	<0.010
Dissolved Silver	0 00012 (f,z)		<0 0050		0.0013 J,B			<0.0050	<0.0050	<0 0050
Dissolved Zinc	0.0657 (j,k,z)		0 014 J,B		0.019 J,B			0.0052 J,B	0.01 J,B	0.0088 J,B
Dissolved Mercury	0.0000013 (a)		<0.00020		<0 00020			<0.00020	<0 00020	<0.00020
Hardness, as $CaCO_3$		na	na	na	na	na		na	na	

NOTES:

*Black **BOLD** values indicate exceedences of EPA Region V, RCRA Ecological Screening criteria*
U or <. Compound not detected above MDL
J Compound detected at concntration below reporting limit
Sch. Creek = Schoenberger Creek
na not analyzed
[1]. U S EPA Region V, RCRA Ecological Screening Levels. August 22, 2003
a: derived from Michigan water quality standards, Rule 57 water quality values

f. derived from Minnesota water quality standards Rule 7050.0100, Subpart 2 (water ESL data for arsenic and benzene represents aquatic life chronic standards and dioxin, DDT, mercury and PCBs represent wildlife values) April 13, 2000 Rule 7050.0222 Subpart 2
j. USEPA national recommended water quality criteria 2002 (EPA 822-R-02-047)
k for hardness dependant metals (Cd, Cr+3, Cu, Pb, Zn) freshwater chronic criteria are based on a defualt total hardness value of 50 mg/L as CaCO3 This surface water ESL may be recalculated when site specific hardness values are available.
z New ESL is lower than the previous table
[3] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed
[4] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed downgradient of West Ditch discharge
[5] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34).

Table 5-3
Physical Appearance of Sediments and Bioassay Results
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS

Sediment Identification	Location	Description (Prior to Bioassay)	Percent Survival
Laboratory Control	--	Shredded brown paper toweling	87.5
SD-CT-01 (Field Control)	North end of East Ditch #1.	Dark clayey loam with decaying vegetation, no odor, no oily sheen, oligochaetes and three midges were removed.	0
SD-CT-05	Confluence of East Ditch #1 with East Ditch #2.	Dark brownish clay with decaying vegetation, no odor or oily sheen, rust-iron layer, no macroinvertebrates were observed.	0
SD-CT-06	In East Ditch #1, south of East Ditch #2 confluence.	Dark clayey loam with decaying vegetation, oligochaetes and two midges were removed.	0 (1 midge)
SD-CT-08	Rose Creek, just west of East Ditch #1 confluence.	Black clayey silt with decaying vegetation, no odor or oily sheen, some oligochaetes were removed.	0
SD-CT-13*	Rose Creek, approximately 4500 feet downstream (west) of confluence with West Ditch #1 and #2	Grayish clay silt, less vegetation, no odor or oily sheen, no macroinvertebrates were found.	0
SD-CT-34	West Ditch Outfall#1, edge of open pond in Old Cahokia Creek Watershed, approximatey 350 feet NW of 29.	Black clay with duck weed (Lemna sp.) and other vegetation, no odor or oily sheen, some oligochaetes were found.	0
SD-CT-36	Shoenberger Creek, at northern-most discharge structure draining water from watershed on the NE side of the creek.	Black clay with big pieces of twigs and some decaying vascular plant material, no odor or oily sheen, a few oligochaetes were removed.	0

* The sediment sample for chemical analysis designated SD-13 was collected from the ditch just to the southeast of the road (e.g., roughly 200 feet downgradient).

TABLE 5-4
SUMMARY OF ANALYSES OF BENTHIC MACRO-INVERTEBRATE TISSUE (BT) SAMPLES AND CO-LOCATED SEDIMENT (SD) SAMPLES
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

ID	BT-SD-001*	SD-01-0.5	BT-SD-005	SD-05-0.5	BT-SD-006	BT-SD-006DUP	BT-SD-006 (average)	SD-06-0.5	BT-SD-008	SD-08-0.5
Location	East Ditch	East Ditch	East Ditch	East Ditch	East Ditch	East Ditch	East Ditch	East Ditch	Rose Creek	Rose Creek (at-site)
ANALYTE	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Arsenic	0.41	17	0.46	130	0.36 U	0.35 U	--	8.5	0.37 U	29
Barium	0.89	240	0.65	480	0.42 U	0.41 U	--	200	3.0	380
Cadmium	0.46	130	0.9	270	0.077	0.069	0.073	61	2.2	460
Chromium	0.15	33	0.19	24	0.1 U	0.098 U	--	14	0.16	74
Lead	2.4	870	2.1	3,300	0.17	0.36	0.265	100	4.9	1,700
Mercury	0.029	6.1	0.015 U	8.8	0.013 U	0.015 U		2.2	0.013 U	6.4
Selenium	0.74	4.5	1.1	5.4	1.0	0.87	0.935	1.7	0.69	5.5
Silver	0.15 U	29	0.15 U	64	0.15 U	0.15 U	--	1.2	0.16 U	17
Zinc	24.6	10,000	50.0	18,000	22.1	18.3	20.2	2,600	169	25,000

ID	BT-SD-013	SD-13-0.5	BT-SD-022	SD-22-0.5	BT-SD-034	SD-034	BT-SD-036	SD-36	BT-SD-037	SD-037
Location	Rose Creek	Rose Creek	Shoenberger	Shoenberger	West Ditch Outfall	West Ditch Outfall	Shoenberger	Shoenberger	Shoenberger	Shoenberger
ANALYTE	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Arsenic	0.62	140	0.37 U	12	0.37 U	15	1.1	13	0.35 U	15
Barium	1.0	290	1.5	640	10.9	210	13.3	270	0.82	340
Cadmium	1.3	100	0.031 U	21	0.50	300	0.096	19	0.050	44
Chromium	0.21	31	0.37	250	0.1 U	17	0.18	53	0.20	230
Lead	1.4	680	0.32	230	0.22	440	0.50	70	0.15	150
Mercury	0.014 U	1.0	0.014 U	0.30	0.017 U	0.31	0.016 U	0.22	0.014 U	0.25
Selenium	0.88	2.4	0.82	1.3	0.49	1.85	0.72	0.89	0.62	1.8
Silver	0.15 U	1.8	0.16 U	0.86	0.16 U	3.0	0.15 U	0.23	0.15 U	0.96
Zinc	32.6	9,200	11.8	940	75.8	35,000	13.3	750	13.3	1,100

B - Analyte detected in laboratory control blanks
U - Analyte not detected at the Reporting Limit.
All results are on a dry weight basis.
* On-facility upstream location

TABLE 5-5
SUMMARY OF ANALYSES OF PLANT TISSUE (PT) SAMPLES AND CO-LOCATED SEDIMENT (SD) SAMPLES
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS

ANALYTE	Approximate Concentrations in Mature Leaf Tissue (ppm dwt)[4]				PT-REF [1] (mg/kg dwt)		PT-SD-16 [2] (mg/kg dwt)		SD-16-0.5 (mg/kg)	PT-SD-31 [3] (mg/kg dwt)		PT-SD-31 (duplicate) [3] (mg/kg dwt)		SD-31-0.5 (mg/kg)	SD-45-0.54[3] (mg/kg)
	Deficient	Sufficient or Normal	Excessive or Toxic	Tolerable in Agronomic Crops											
Arsenic	--	1 - 1.7	5 - 10	--	0.35	U	0.35	U	8.2	0.35	U	0.36	U	8.0	15
Barium	--	--	500	--	5.9	B	3.9	B	220	4.2	B	3.5	B	220	210
Cadmium	--	0.05 - 0.2	5 - 30	--	0.93		**3.2**		1.1	**4.0**		**3.7**		32	56
Chromium	--	0.1 - 0.5	5 - 30	--	1.3		0.57	B	19	0.42	B	0.29	B	14	19
Lead	--	5 - 10	30 -300	--	0.27	B	**1.7**		33	**1.3**		**0.9**		52	220
Mercury	--	--	1-3	--	0.016	U	0.016	U	0.078	0.015	U	0.016	U	0.042	0.11
Selenium	--	0.01 - 2	5 - 30	--	0.45	B	**0.56**	**B**	<1.4	**0.83**	**B**	**0.53**	**B**	0.89	1.1
Silver	--	0.5	5 - 10	--	0.15	U	0.15	U	0.24	0.15	U	0.15	U	0.24	1.2
Zinc	10-20	27-150	100 - 400	300	19.8	E	**84.9**	**E**	140	**287**	**E**	**276**	**E**	7,900	16,000

Bold indicates investigative sample tissue concentration exceeded reference tissue concentration.

1 - Reference locations between Rose Creek and West Ditch Outfalls; no co-located sediment sample collected.
2 - Rose Creek Outfall.
3 - West Ditch Outfall; sediment data for SD-45 also presented because this location is more representative of the depositional environment and was close to the tissue sample location.
4 - Kabata-Pendias, Alina and Henryk Pendias. 1992. Traces Elements in Soils and Plants, 2nd Edition. CRC Press, Boca Raton, FL.

B - Analyte detected in laboratory control blanks
U - Analyte not detected at the Reporting Limit.
dwt = dry weight
ppm = parts per million

Table 5-6
Benthic Macroinvertebrate Community Analysis
Former American Zinc Plant Site
Fairmont City, Illinois

		Family MBI Tolerance Value[1]	Sample Number									
			BT-SD-01	BT-SD-05	BT-SD-06	BT-SD-02	BT-SD-08	BT-SD-13	BT-SD-34	BT-SD-22	BT-SD-36	BT-SD-37
			Sample Location									
			East Ditch 1 at origin	East Ditch 1 at mouth of East Ditch 2	East Ditch 1 downstream of East Ditch 2	East Ditch 2 composite (1 sweep only)	Rose Creek at discharge of East Ditch 1	Rose Creek upstream of Collinsville Road	Shallow marsh discharge of West Ditch 1	Schoenberger Creek upstream of Collinsville Road	Schoenberger Creek at discharge of the Engineered Ditch	Schoenberger Creek downstream of discharge of the Engineered Ditch
Macroinvertebrates Observed			Sample Date									
Taxon	Common Name		6/27/2006	6/27/2006	6/28/2006	6/27/2006	6/28/2006	6/29/2006	6/28/2006	6/30/2006	6/29/2006	6/29/2006
Planorbidae	Orb snails							●	●	●	●	●
Physidae	Pond snails	8	10	10	10	10	10	10	10	10	10	10
Lymnaeidae	Aquatic snails	6				4				2	2	1
Oligochaeta	Aquatic earthworms	8								3	1	2
Hirudinea	Leeches	10		1			2		2	2	2	2
Trombidiformes	Water mites		●		●		●					
Cambaridae	Crayfish	6								1		
Baetidae	Small minnow mayflies	4	10	10	10	10	10			10	10	10
Caenidae	Small square-gilled mayflies	7			1							
Coenagrionidae	Narrowwinged damselflies	9	10	10	10		10			10	10	10
Calopterygidae	Broadwinged damselflies	5						10				
Aeschnidae	Darner dragonflies	3	10	10	10		10	10		10	10	10
Libellulidae	Skimmer dragonflies	9	2	2	1		10			4	10	
Belastomatidae	Giant water bugs		●	●	●		●		●	●	●	●
Pleidae	Pygmy backswimmers		●									
Nepidae	Water scorpions			●	●		●			●		
Notonectidae	Backswimmers		●	●	●	●	●			●		
Corixidae	Water boatmen		●				●					●
Gerridae	Water striders				●					●	●	
Hydrometridae	Marsh treaders		●									
Mesoveliidae	Water treaders			●	●		●	●				
Dytiscidae	Predaceous diving beetles		●	●	●	●	●		●	●	●	●
Hydrophilidae	Water scavenger beetles		●	●				●			●	●
Haliplidae	Crawling water beetles		●							●		
Chironomidae	Non-biting midges	8	10	10	10		10	10		10		10
Culicidae	Mosquitoes						●	●			●	
Chaoboridae	*Phantom midges*			●								
Ceratopogonidae	Biting midges	6	1	2	3					4	4	
Stratomyidae	Soldierflies			●			●					
Tabanidae	Horseflies	6									1	

Table 5-6
Benthic Macroinvertebrate Community Analysis
Former American Zinc Plant Site
Fairmont City, Illinois

		Family MBI Tolerance Value[1]	Sample Number									
			BT-SD-01	BT-SD-05	BT-SD-06	BT-SD-02	BT-SD-08	BT-SD-13	BT-SD-34	BT-SD-22	BT-SD-36	BT-SD-37
			Sample Location									
			East Ditch 1 at origin	East Ditch 1 at mouth of East Ditch 2	East Ditch 1 downstream of East Ditch 2	East Ditch 2 composite (1 sweep only)	Rose Creek at discharge of East Ditch 1	Rose Creek upstream of Collinsville Road	Shallow marsh discharge of West Ditch 1	Schoenberger Creek upstream of Collinsville Road	Schoenberger Creek at discharge of the Engineered Ditch	Schoenberger Creek downstream of discharge of the Engineered Ditch
Macroinvertebrates Observed			Sample Date									
Taxon	Common Name		6/27/2006	6/27/2006	6/28/2006	6/27/2006	6/28/2006	6/29/2006	6/28/2006	6/30/2006	6/29/2006	6/29/2006
No. MBI organisms			53	55	55	24	62	40	12	66	60	55
$MBI^{3,5}$			6.49	6.55	6.44	6.00	6.94	6.00	8.33	6.70	6.67	6.58
				55.00	55.00	24.00	62.00	40.00	12.00	66.00	60.00	55.00
$TBI^{4,5}$			6.71	7.13	6.75	6.00	7.29	6.00	9.00	7.00	6.90	7.00
Total number of taxa			16	16	15	5	16	8	5	18	16	13

Notes:

1. Family MBI tolerance values (t_i) are from Hilsenhoff, 1988 and Bode, 1988

● = taxon present, but has no MBI tolerance value

2. A maximum of 10 organisms was used for MBI calculations, according to Hilsenhoff, 1998.
3. Macroinvertebrate Biotic Index (MBI) = $\sum n_i t_i)/N$ where n_i = no. individuals in each listed taxon, t_i = tolerance rating for each listed taxon, and N = total no. of listed organisms counted (IEPA, 2002).
4. Mean tolerance value (TBI)=$\sum t_i/T$ where t_i=tolerance value for each listed taxon and T=no. of listed taxa in the sample (from Lillie and Schlesser, 1994).
5. Biotic Index (MBI and TBI) Interpretation (from Hilsenhoff, 1987)

Value	Water Quality	Degree of Organic Pollution
0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very Good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organic pollution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.00	Very Poor	Severe organic pollution

Table 5-7
Benthic Macroinvertebrate Community Indices
Former American Zinc Plant Site
Fairmont City, Illinois
June 2006

No.of Taxa	Location	East Ditch 1 at origin	East Ditch 1 at mouth of East Ditch 2	East Ditch 1 downstream of East Ditch 2	East Ditch 2 composite (1 sweep only)	Rose Creek at discharge of East Ditch 1	Rose Creek upstream of Collinsville Road	Shallow marsh discharge of West Ditch 1	Schoenberger Creek upstreram of Collinsville Road	Schoenberger Creek at discharge of the Engineered Ditch	Schoenberger Creek downstream of discharge of the Engineered Ditch
16	East Ditch 1 at origin		0.69	0.71	0.38	0.69	0.33	0.28	0.65	0.56	0.62
16	East Ditch 1 at mouth of East Ditch 2	0.52		0.77	0.38	0.81	0.42	0.38	0.70	0.62	0.62
15	East Ditch 1 downstream of East Ditch 2	0.55	0.63		0.40	0.77	0.35	0.30	0.73	0.58	0.50
5	East Ditch 2 composite (1 sweep only)	0.24	0.24	0.25		0.38	0.15	0.40	0.43	0.38	0.44
16	Rose Creek at discharge of East Ditch 1	0.52	0.68	0.63	0.24		0.42	0.38	0.65	0.56	0.62
8	Rose Creek upstream of Collinsville Road	0.20	0.26	0.21	0.08	0.26		0.31	0.31	0.42	0.48
5	Shallow marsh discharge of West Ditch 1	0.17	0.24	0.18	0.25	0.24	0.18		0.43	0.48	0.56
18	Schoenberger Creek upstreram of Collinsville Road	0.48	0.54	0.57	0.28	0.48	0.18	0.28		0.76	0.71
16	Schoenberger Creek at discharge of the Engineered Ditch	0.39	0.45	0.41	0.24	0.39	0.26	0.31	0.62		0.69
13	Schoenberger Creek downstream of discharge of the Engineered Ditch	0.45	0.45	0.33	0.28	0.45	0.31	0.38	0.55	0.53	

Jaccard's Coefficient = C/A+B-C
Community Similarity Index = S = 2C/(A+B)
where A = no. taxa in Sample 1
B = no. taxa in Sample 2
C = no. taxa common to both samples

TABLE 5-8
SUMMARY OF PLANT COMMUNITY STUDY
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS

Plant Community Metric	West Ditch Outfall						Rose Creek Outfall				Reference			
	Native Species Richness			Total Species Richness[e]			Native Species Richness		Total Species Richness[e]		Native Species Richness		Total Species Richness[e]	
	Plot 1	Plot 2	Plot 3[a]	Plot 1	Plot 2	Plot 3[a]	Plot 1	Plot 2[b]	Plot 1	Plot 2	Plot 1[c]	Plot 2[d]	Plot 1	Plot 2
Total Coefficient of Conservatism (Total C)	8	13	25	8	13	25	41	46	41	46	15	64	15	64
Number of native species (N)	2	3	10	2	3	10	16	21	16	16	6	22	6	22
Mean C	4	4.33	2.50	2.67	3.25	1.92	2.6	2.19	2.05	1.77	2.5	2.9	1.7	2.7
Floristic Quality Index (FQI)	5.7	7.51	7.91	4.62	6.50	6.93	10.3	10.04	9.17	9.02	6.1	13.6	5.0	13.1
Total number of native and non-native species (Total N)	3	4	13	3	4	13	20	26	20	26	9	25	9	25
Percent native species	66.7	75	76.9	66.7	75.0	76.9	80.0	80.8	80.0	61.5	66.7	88.0	66.7	88.0
Average FQI by Location	7.02			6.02			10.1		9.1		9.9		9.0	

a Closest to the stormwater outfall from West Ditch.
b Depositional environment most similar to West Ditch Outfall Plots 1 & 2 and Reference Plot
c Plot location on landscape, hydrology, etc. compares most directly with West Ditch Outfall Plot #3
d Similar hydrology and topography to West Ditch plots 2 & 3 and Rose Creek plots.
e FQI including adventives and non-natives.

Table 6-1
Summary of PEC-Quotients for Metals in Sediment Samples
Old American Zinc Plant Site, Fairmont City, Illinois

	Facility Drainage Ditch Investigative Samples	
Sample ID:	Location	Mean PEC-Q metals*
SD-01-0.5	East Ditch 1	11.05
SD-02-0.5	East Ditch 2	2.57
SD-05-0.5	East Ditch 1	24.53
SD-06-0.5	East Ditch 1	3.80
SD-07-0.5	West Ditch 2	19.83
SD-07-0.5/FD	West Ditch 2	14.54
SD-23-0.5	West Ditch 1	14.41
SD-23-0.5/FD	West Ditch 1	14.63
SD-24-0.5	West Ditch 1	52.11
SD-25-0.5	West Ditch 1	9.20
SD-25-0.5/FD	West Ditch 1	72.41
SD-26-0.5	West Ditch 1	13.12
SD-27-0.5	West Ditch 1	12.85
SD-28-0.5	West Ditch 1	9.88
	Rose Creek Investigative Samples	
Sample ID:	Location	Mean PEC-Q metals*
SD-08-0.5	Rose Creek (at-site)	32.20
SD-09-0.5	Rose Creek	13.71
SD-41	Rose Creek	23.61
SD-41-D	Rose Creek	18.91
SD-42	Rose Creek	22.37
SD-10-0.5	Rose Creek	14.36
SD-11-0.5	Rose Creek	3.83
SD-12-0.5	Rose Creek	2.38
SD-12/FD	Rose Creek	3.42
SD-13-0.5	Rose Creek	9.95
SD-43	Rose Creek	8.09
SD-44	Rose Creek	6.28
	Rose Creek Upstream Samples	
Sample ID:	Location	Mean PEC-Q metals*
SD-03-0.5	Ditch along Kingshwy	4.12
SD-04-0.5	Rose Creek (upstream)	1.32
RSD-1	Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	1.61
RSD-2	Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	2.27
RSD-3	Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	1.27
RSD-4	Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	2.35
	Rose Creek Outfall Investigative Samples	
Sample ID:	Location	Mean PEC-Q metals*
SD-14-0.5	Rose Creek Outfall	1.72
SD-15-0.5	Rose Creek Outfall	1.07
SD-16-0.5	Rose Creek Outfall	0.24
SD-17-0.5	Rose Creek Outfall	1.74
SD-18-0.5	Rose Creek Outfall	1.81
TRC-2-S-0-6	Old Cahokia Watershed [6]	52.20
TRC-2-S-8-10	Old Cahokia Watershed [6]	82.46
TRC-2-S-12-14	Old Cahokia Watershed [6]	19.93
TRC-2-S1-0-6	Old Cahokia Watershed [6]	15.21

Table 6-1
Summary of PEC-Quotients for Metals in Sediment Samples
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID:	Location	Mean PEC-Q metals*
West Ditch Outfall Investigative Samples		
SD-29-0.5	West Ditch 1 Outfall	4.14
SD-30-0.5	West Ditch 1 Outfall	5.43
SD-31-0.5	West Ditch 1 Outfall	4.87
SD-32-0.5	West Ditch 1 Outfall	7.07
SD-33-0.5	West Ditch 1 Outfall	0.64
SD-034	Cahokia Watershed [3]	28.02
SD-034-D	Cahokia Watershed [3]	34.88
SD-38	Cahokia Watershed [4]	11.50
SD-39	Cahokia Watershed [4]	2.82
SD-40	Cahokia Watershed [4]	7.20
SD-45	Cahokia Wetland [2]	10.05
SD-46	Cahokia Wetland [2]	18.88
SD-47	Cahokia Wetland [2]	16.50
SD-48	Cahokia Wetland [2]	19.29
TWD-02-C-0-6	Old Cahokia Watershed [5]	7.48
TWD-02-C-6-9	Old Cahokia Watershed [5]	1.61
TWD-02-C-6-9 D	Old Cahokia Watershed [5]	1.38
TWD-02-S-0-6	Old Cahokia Watershed [5]	11.75
TWD-02-S-6-8	Old Cahokia Watershed [5]	2.93
West Ditch Outfall Reference Samples		
Sample ID:	Location	Mean PEC-Q metals*
TWD-1-N-0-6	Old Cahokia Watershed [5]	2.89
TWD-1-N-6-8	Old Cahokia Watershed [5]	0.42
TWD-1-C-0-6	Old Cahokia Watershed [5]	2.81
TWD-1-C-6-10	Old Cahokia Watershed [5]	1.35
TWD-1-S-0-6	Old Cahokia Watershed [5]	5.39
TWD-1-S-6-9.5	Old Cahokia Watershed [5]	1.40
TWD-02-N-0-6	Old Cahokia Watershed [5]	2.07
TWD-02-N-6-7	Old Cahokia Watershed [5]	2.43
TWD-03-N-0-6	Old Cahokia Watershed [5]	1.93
TWD-03-N-6-8	Old Cahokia Watershed [5]	1.22
TWD-03-C-0-6	Old Cahokia Watershed [5]	2.21
TWD-03-C-6-8.5	Old Cahokia Watershed [5]	1.49
TWD-03-S-0-6	Old Cahokia Watershed [5]	2.00
TWD-03-S-6-8	Old Cahokia Watershed [5]	1.34
TWD-03-S-10-12	Old Cahokia Watershed [5]	1.28
Rose Creek Outfall Reference Samples		
Sample ID:	Location	Mean PEC-Q metals*
SD-50-0-6	Old Cahokia Creek	1.17
SD-50-8-10	Old Cahokia Creek	1.37
SD-51-DITCH-0-6	Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	4.97
SD-51-DITCH-8-10	Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	13.86
SD-51-DITCH-12-14	Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	6.29
TRC-3-S-0-6	Old Cahokia Watershed [6]	2.08
TRC-3-S-7-9	Old Cahokia Watershed [6]	3.01
Impoundment Samples		
Sample ID:	Location	Mean PEC-Q metals*
TRC-1-N-0-6	Old Cahokia Watershed [6]	0.83
TRC-1-N-6-8	Old Cahokia Watershed [6]	0.41
TRC-1-S-0-6	Old Cahokia Watershed [6]	0.81
TRC-1-S-0-6-D	Old Cahokia Watershed [6]	0.78
TRC-1-S-6-8	Old Cahokia Watershed [6]	0.61
TRC-2-N-0-6	Old Cahokia Watershed [6]	0.06
TRC-2-N1-0-6	Old Cahokia Watershed [6]	0.11
TRC-2-N1-6-8	Old Cahokia Watershed [6]	0.17
TRC-2-C-0-6	Old Cahokia Watershed [6]	0.39
TRC-2-C-10-12	Old Cahokia Watershed [6]	0.13
TRC-3-N-0-6	Old Cahokia Watershed [6]	0.06
TRC-3-N-0-6/FD	Old Cahokia Watershed [6]	0.06
TRC-3-N-8-10	Old Cahokia Watershed [6]	0.03

Table 6-1
Summary of PEC-Quotients for Metals in Sediment Samples
Old American Zinc Plant Site, Fairmont City, Illinois

Schoenberger Creek Samples		
Sample ID:	Location	Mean PEC-Q metals*
SD-20-0.5	Sch. Creek	1.01
SD-20-0.5/FD	Sch. Creek	0.91
SD-21-0.5	Sch. Creek	0.98
SD-36	Sch. Creek	0.63
SD-037	Sch. Creek	1.27
SD-22-0.5	Sch. Creek	1.31
SD-52	Schoenberger Creek - west of Old Cahokia western boundary	2.12

** Denotes background samples*
Sch. Creek = Schoenberger Creek
[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed.
[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.
[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34).
[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area
[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area.

* Based on EPA (2002), only includes arsenic, cadmium, chromium,copper, lead, and zinc.
FD = Field duplicate
D = Duplicate

Table 6-2a
Concentrations of Dissolved Metals (mg/L) in Surface Water Samples Compared to IEPA Water Quality Criteria
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID:	SW-01	SW-05	SW-06	SW-24	SW-07	SW-07-FD		Ditch	
Date Collected:	5/31/2006	5/31/2006	5/31/2006	6/1/2006	6/2/2006	6/2/2006		AS	CS
Location	East Ditch 1	East Ditch 1	East Ditch 1	West Ditch 1	West Ditch 2	West Ditch 2		(mg/L)	(mg/L)
Dissolved Arsenic	0.0074 B	<0.010 U	<0.010 U	0.0023 B	<0.010 U	<0.010 U		0.36	0.19
Dissolved Barium	0.078	0.0061 B	0.0060 B	0.044	0.086	0.086		--	--
Dissolved Cadmium	<0.0020 U	<0.002 U	<0.0020 U	**0.0074**	**0.18**	**0.17**		0.0085	0.0010
Dissolved Chromium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U		0.515	0.111
Dissolved Copper	na	na	na	na	na	na		0.016	0.011
Dissolved Lead	0.0028 B	<0.0050 U	0.0035 B	0.0039 B	**0.041**	**0.038**		0.070	0.015
Dissolved Selenium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U		--	0.005
Dissolved Silver	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U		--	--
Dissolved Zinc	**0.021**	**0.037**	0.0089 B	**19**	**36**	**35**		0.112	0.020
Dissolved Mercury	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U		0.0022	0.0011

Sample ID:	SW-12	SW-12/FD	SW-13	SW-17	SW-08	SW-10		Rose Creek	
Date Collected:	6/12/2006	6/12/2006	6/12/2006	6/12/2006	5/31/2006	6/12/2006		AS	CS
Location	Rose Creek	Rose Creek	Rose Creek	Rose Creek Outfall	Rose Creek	Rose Creek		(mg/L)	(mg/L)
Dissolved Arsenic	0.0028 B	0.0029 B	<0.010 U	0.0053 B	0.0022 B	0.0078 B		0.36	0.19
Dissolved Barium	0.060	0.060	0.060	0.060	0.012	0.034		--	--
Dissolved Cadmium	0.00056 B	0.00060 B	0.00087 B	0.00056 B	<0.0020 U	**0.014**		0.0102	0.0011
Dissolved Chromium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U		0.59	0.13
Dissolved Copper	na	na	na	na	na	na		0.019	0.012
Dissolved Lead	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U		0.0840	0.0176
Dissolved Selenium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U	<0.010 U		--	0.005
Dissolved Silver	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U		--	--
Dissolved Zinc	**0.098**	**0.090**	**0.27**	**0.27**	0.015 B	**1.6**		0.130	0.023
Dissolved Mercury	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U	<0.00020 U		0.0022	0.0011

Sample ID:	SW-11	SW-41 (TOTAL)	SW-41 Resample	SW-41-D (TOTAL)	SW-41 D Resample	SW-42 (TOTAL)*		Rose Creek	
Date Collected:	6/12/2006	12/12/2006	7/19/2007	12/12/2006	7/19/2007	12/12/2006		AS	CS
Location	Rose Creek	Rose Creek	Rose Creek	Rose Creek	Rose Creek	Rose Creek		(mg/L)	(mg/L)
Dissolved Arsenic	0.0045 B	<0.010	<0.010	<0.010	<0.010	<0.010		0.36	0.19
Dissolved Barium	0.044	0.045	0.044	0.045	0.054	0.053		--	--
Dissolved Cadmium	**0.0040**	**0.21**	**0.03**	**0.19**	**0.0310**	**0.19**		0.0102	0.0011
Dissolved Chromium	<0.010 U	<0.010	<0.010	<0.010	0.0017 J	0.0024 J		0.59	0.13
Dissolved Copper	na	0.011	0.0075 J	0.011	0.0088 J	0.011		0.019	0.012
Dissolved Lead	<0.0050 U	<0.0050	<0.0050	0.0046 J	<0.0050	<0.0050		0.0840	0.0176
Dissolved Selenium	<0.010 U	0.0048 J	<0.010	<0.010	<0.010	<0.010		--	0.005
Dissolved Silver	<0.0050 U	<0.0050	<0.0050	<0.0050	0.0012 J,B	0.0013 J		--	--
Dissolved Zinc	**0.46**	**31**	**4.2** B	**28**	**4.2** B	**23**		0.130	0.023
Dissolved Mercury	<0.00020 U	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020		0.0022	0.0011

Sample ID:	SW-43 (TOTAL)	SW-43 Resample	SW-44 (TOTAL)	SW-44 Resample				Rose Creek	
Date Collected:	12/12/2006	7/18/2007	12/12/2006	7/18/2007				AS	CS
Location	Rose Creek	Rose Creek	Rose Creek	Rose Creek				(mg/L)	(mg/L)
Dissolved Arsenic	<0.010	0.0036 J	<0.010	0.019				0.36	0.19
Dissolved Barium	0.043	0.031	0.054	0.04				--	--
Dissolved Cadmium	**0.0055**	<0.0020	**0.0080**	0.001 J				0.0102	0.0011
Dissolved Chromium	0.0024 J	<0.010	0.0023 J	0.0023 J				0.59	0.13
Dissolved Copper	0.0086 J	0.0035 J	0.0076 J	0.0032 J				0.019	0.012
Dissolved Lead	<0.0050	<0.0050	<0.0050	<0.0050				0.0840	0.0176
Dissolved Selenium	<0.010	<0.010	<0.010	<0.010				--	0.005
Dissolved Silver	<0.0050	0.0025 J,B	0.0017 J	0.002 J,B				--	--
Dissolved Zinc	**0.84**	**0.035** B	**1.4**	**0.5** B				0.130	0.023
Dissolved Mercury	<0.00020	<0.00020	<0.00020	<0.00020				0.0022	0.0011

Sample ID:	SW-20	SW-20/FD	SW-21	SW-22	SW-36	SW-37	SW-52	Schoenberger Creek	
Date Collected:	6/13/2006	6/13/2006	6/12/2006	6/13/2006	6/29/2006	6/29/2006	12/12/2006	AS	CS
Location	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Sch. Creek	Schoenberger Creek - west of Old Cahokia Watershed	(mg/L)	(mg/L)
Dissolved Arsenic	0.0042 B	0.0056 B	0.0042 B	<0.010 U	<0.010 U	<0.010 U	<0.010	0.36	0.19
Dissolved Barium	0.082	0.081	0.13	0.082	0.14	0.11	0.032	--	--
Dissolved Cadmium	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020 U	<0.0020	0.019	0.0017
Dissolved Chromium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	0.0017 B	0.0013 B	<0.010	0.948	0.205
Dissolved Copper	na	na	na	na	na	na	<0.010	0.032	0.02
Dissolved Lead	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050	0.155	0.033
Dissolved Selenium	<0.010 U	<0.010 U	<0.010 U	<0.010 U	**0.0078** B	<0.010 U	<0.010	--	0.005
Dissolved Silver	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050 U	<0.0050	--	--
Dissolved Zinc	0.0078 B	<0.020 U	0.0079 B	0.012 B	0.012 B	0.0067 B	0.01 J,B	0.21	0.038
Dissolved Mercury	<0.00020 U	<0.00020 U	<0.00020 U	0.00013 B	<0.00020 U	<0.00020 U	<0.00020	0.002	0.0011

Sample ID:	SW-45 (TOTAL)*	SW-34	SW-34-D	SW-38 (TOTAL)	SW-38 Resample	SW-39 (TOTAL)	SW-39 Resample	Cahokia Watershed	
Date Collected:	12/12/2006	6/28/2006	6/28/2006	12/12/2006	7/18/2007	12/12/2006	7/18/2007	AS	CS
Location	Cahokia Wetland [3]	Outfall -Cahokia Watershed [4]	Cahokia Watershed [4]	Reference [5]	Reference [5]	Reference [5]	Reference [5] - 40 feet east of SW-38	(mg/L)	(mg/L)
Dissolved Arsenic	<0.010	0.0030 B	<0.010 U	<0.010	0.0034 J	<0.010	0.0034 J	0.36	0.19
Dissolved Barium	0.044	0.072	0.082	0.057	0.042	0.045	0.042	--	--
Dissolved Cadmium	**1.0**	<0.0020 U	<0.0020 U	**0.25**	<0.0020	**0.16**	<0.0020	0.074	0.0043
Dissolved Chromium	0.0028 J	0.0019 B	<0.010 U	0.0018 J	0.0033 J	0.0026 J	0.0033 J	2.67	0.58
Dissolved Copper	**1.9**	na	na	0.022	0.003 J	0.021	0.003 J	0.11	0.059
Dissolved Lead	0.0040 J	<0.0050 U	<0.0050 U	<0.0050	<0.0050	<0.0050	<0.0050	0.57	0.12
Dissolved Selenium	<0.010	0.0049 B	0.0047 B	<0.010	<0.010	<0.010	<0.010	--	0.005
Dissolved Silver	0.0011 J	<0.0050 U	<0.0050 U	<0.0050	0.0029 J,B	<0.0050	0.0029 J,B	--	--
Dissolved Zinc	**260**	0.057	0.063	**48**	0.079 B	**43**	0.079 B	0.61	0.11
Dissolved Mercury	<0.00020	<0.00020 U	<0.00020 U	<0.00020	<0.00020	<0.00020	<0.00020	0.0022	0.0011

Table 6-2a
Concentrations of Dissolved Metals (mg/L) in Surface Water Samples Compared to IEPA Water Quality Criteria
Old American Zinc Plant Site, Fairmont City, Illinois

Sample ID:	SW-40 (TOTAL)	SW-40 Resample	SW-50	SW-TRC-3-S	Cahokia Watershed	
Date Collected:	12/12/2006	7/18/2007	12/12/2006	7/19/2007	AS	CS
Location	Reference [5]	Reference [5] - 75 feet east of SW-38	Cahokia Watershed - Upgradient of Rose Creek Discharge Area	West end of Old Cahokia Watershed, adjacent to Schoenberger Creek channel	(mg/L)	(mg/L)
Dissolved Arsenic	<0.010	<0.010	<0.010	<0.010	0.36	0.19
Dissolved Barium	0.052	0.065	0.036	0.11	--	--
Dissolved Cadmium	**0.19**	<0.0020	<0.0020	<0.0020	0.074	0.0043
Dissolved Chromium	0.0026 J	<0.010	<0.010	<0.010	2.67	0.58
Dissolved Copper	0.019	<0.010	<0.010	<0.010	0.11	0.059
Dissolved Lead	<0.0050	<0.0050	<0.0050	<0.0050	0.57	0.12
Dissolved Selenium	<0.010	<0.010	<0.010	<0.010	--	0.005
Dissolved Silver	0.0015 J	0.0013 J,B	<0.0050	<0.0050	--	--
Dissolved Zinc	**45**	0.019 J,B	0.0052 J,B	0.0088 J,B	0.61	0.11
Dissolved Mercury	<0.00020	<0.00020	<0.00020	<0.00020	0.0022	0.0011

NOTES:

BOLD values indicate exceedences of IEPA chronic standard; BOLD and shading indicates exceeds IEPA acute standard.
U or <: Compound not detected above MDL
J: Compound detected at concntration below reporting limit.
Sch. Creek = Schoenberger Creek
AS = Acute standard; See Table 6-2b for derivation of hardness-dependent criteria.
CS = Chronic standard; See Table 6-2b for derivation of hardness-dependent criteria.
na: not analyzed
[3] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed. Sample was not filtered.
[4] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.
[5] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34). Sample was not filtered.
Samples collected in December 2006 were not filtered.
Total values presented if a filtered sample was not available, though criteria are based on dissolved.
* SW-42 and SW-45 were proposed for re-sampling in July 2007; however, there was no water in creek at SW-42 and no water in discharge channel at SW-45 on this sampling date.

Table 6-2b
Calculation of Hardness-Dependent Aquatic Life Standards
35 IAC Part 302.204

			Dissolved Standards							
		Waterbody	**Ditch**		**Rose Creek**		**Schoenberger Creek**		**Cahokia Watershed**	
		Hardness	**92.5**		**110.0**		**195**		**690**	
		ln(Hardness)	**4.53**		**4.70**		**5.27**		**6.54**	
Constituent	**AS (µg/L)**	**CS (µg/L)**	**AS (µg/L)**	**CS (µg/L)**	**AS (µg/L)**	**CS (µg/L)**	**AS (µg/L)**	**CS (µg/L)**	**AS (µg/L)**	**CS (µg/L)**
Arsenic (trivalent, dissolved)	360 X 1.0*=360	190 X 1.0*=190	360	190	360	190	360	190	360	190
Barium	--	--	--	--	--	--	--	--	--	--
Cadmium (dissolved)	exp[A+Bln(H)] X {1.138672-[(lnH)(0.041838)]}*, where A=-2.918 and B=1.128	exp[A+Bln(H)] X {1.101672-[(lnH)(0.041838)]}*, where A=-3.490 and B=0.7852	8.47	0.97	10.22	1.11	19.0	1.69	74.5	4.28
Chromium (trivalent, dissolved)	exp[A+Bln(H)] X 0.316*, where A=3.688 and B=0.8190	exp[A+Bln(H)] X 0.860*, where A=1.561 and B=0.8190	515	111	593	128	948	205	2669	578
Copper (dissolved)	exp[A+Bln(H)] X 0.960*, where A=-1.464 and B=0.9422	exp[A+Bln(H)] X 0.960*. where A=-1.465 and B=0.8545	15.8	10.6	18.6	12.3	31.9	20.1	105.0	59.1
Lead (dissolved)	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}*, where A=-1.301 and B=1.273	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}*, where A=-2.863 and B=1.273	69.5	14.6	84.0	17.6	155	32.6	570	120
Selenium (dissolved)	--	5	--	5	--	5	--	5	--	5
Silver (dissolved)	--	--	--	--	--	--	--	--	--	--
Zinc (dissolved)	exp[A+Bln(H)] X 0.978*, where A=0.9035 and B=0.8473	Exp[A+Bln(H)] X 0.986*, where A=-0.8165 and B=0.8473	112	20.2	130	23.4	210	38.0	614	111
Mercury (dissolved)	2.6 X 0.85*=2.2	1.3 X 0.85*=1.1	2.2	1.1	2.2	1.1	2.2	1.1	2.2	1.1

Sample ID:	**SW-001**	**SW-005**	**SW-10**	**SW-36**	**SW-37**	**SW-34**	**SW-34-D**
Date Collected:	**6/29/2006**	**6/29/2006**	**6/29/2006**	**6/29/2006**	**6/29/2006**	**6/28/2006**	**6/28/2006**
Location	**East Ditch 1**	**East Ditch 1**	**Rose Creek**	**Sch. Creek**	**Sch. Creek**	**Cahokia Watershed**	**Cahokia Watershed**
Hardness, as CaCO3	85	100	110	220	170	590	720
Average hardness	92.5			195		690	

* = conversion factor multiplier for dissolved metals

TABLE 6-3
BENTHIC MACRO-INVERTEBRATE TISSUE SAMPLES COMPARED TO TISSUE RESIDUE EFFECT LEVELS
FORMER OLD AMERICAN ZINC PLANT
FAIRMONT CITY, ILLINOIS
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

ID	TISSUE RESIDUE EFFECT LEVELS[a]		BT-SD-001[b]	HQ= Tissue/LOEC	BT-SD-005	HQ= Tissue/LOEC	BT-SD-006DUP	HQ= Tissue/LOEC	BT-SD-008	HQ= Tissue/LOEC	BT-SD-013	HQ= Tissue/LOEC
Location			East Ditch		East Ditch		East Ditch		Rose Creek		Rose Creek	
ANALYTE	NOEC (wet wt)	LOEC (wet wt)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Arsenic	3.6	4.2	**0.068**	0.02	**0.077**	0.02	0.029	0.01	0.031	0.01	**0.104**	0.02
Barium	NDA	NDA	**0.149**	--	**0.109**	--	0.034	--	**0.501**	--	**0.167**	--
Cadmium	0.5	0.59	**0.077**	0.13	**0.150**	0.25	**0.012**	0.02	**0.367**	0.62	**0.217**	0.37
Chromium	1.44	1.67	**0.025**	0.02	**0.032**	0.02	0.008	0.005	**0.027**	0.02	**0.035**	0.02
Lead	5	5.22	**0.401**	0.08	**0.351**	0.07	**0.044**	0.01	**0.818**	0.16	**0.234**	0.04
Selenium	NDA	0.2	**0.124**	0.62	**0.184**	0.92	**0.156**	0.78	**0.115**	0.58	**0.147**	0.73
Zinc	NDA	11.12	**4.11**	0.37	**8.35**	0.75	**3.37**	0.30	**28.22**	2.54	**5.444**	0.49
		Mean HQ		0.20		0.34		0.19		0.65		0.28

ID	TISSUE RESIDUE EFFECT LEVELS[a]		BT-SD-022	HQ= Tissue/LOEC	BT-SD-034	HQ= Tissue/LOEC	BT-SD-036	HQ= Tissue/LOEC	BT-SD-037	HQ= Tissue/LOEC
Location			Shoenberger		West Ditch Outfall		Shoenberger		Shoenberger	
ANALYTE	NOEC (wet wt)	LOEC (wet wt)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Arsenic	3.6	4.2	0.031	0.01	0.031	0.01	**0.18**	0.04	0.03	0.007
Barium	NDA	NDA	**0.251**	--	**1.820**	--	**2.22**	--	**0.14**	--
Cadmium	0.5	0.59	0.003	0.004	**0.084**	0.14	**0.02**	0.03	**0.01**	0.01
Chromium	1.44	1.67	**0.062**	0.04	0.008	0.01	**0.03**	0.02	**0.03**	0.02
Lead	5	5.22	**0.053**	0.01	**0.037**	0.01	**0.08**	0.02	**0.03**	0.005
Selenium	NDA	0.2	**0.137**	0.68	**0.082**	0.41	**0.12**	0.60	**0.10**	0.52
Zinc	NDA	11.12	**1.971**	0.18	12.66	1.14	**2.22**	0.20	**2.22**	0.20
		Mean HQ		0.15		0.28		0.15		0.13

NDA = No data available.
Tissue was analyzed on a dry weight basis. Percent moisture was not available from the laboratory.
Values were converted to wet tissue weight assuming that benthic invertebrate moisture content of 83.3 (by mass) percent (Pietz et al., 1984, as cited in EPA, 1999).
Ctissue (wet weight) = Ctissue (dry weight) x (1 - % water)

Mercury and silver were not positively detected in tissue samples.
Duplicate samples were averaged.
Bold indicates detected concentration; non-detects presented at one-half the detection limit.
NOEC = No observed effect concentration.
LOEC = Lowest observed effect concentration.
Shading and underline indicates exceeds LOEC.
a = See Appendix E for derivation of tissue residue effect levels.
b = Upgradient location in East Ditch (at origin).
HQ = Hazard Quotient
Bold indicates detected concentration; non-detects presented at one-half the detection limit.
Bold text indicates detected concentration; one-half detection limit used as proxy value for non-detects

Table 6-4
Lines of Evidence for Assessing Impacts on Aquatic Ecosystems
Former Old American Zinc Plant
Fairmont City, IL
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

Line of Evidence	Sample No./Location									
	SD-01 East Ditch 1 at origin	**SD-02** East Ditch 2	**SD-05** East Ditch 1 at mouth of East Ditch 2	**SD-06 & Duplicate** East Ditch 1 downstream of East Ditch 2	**SD-08 & Duplicate** Rose Creek at discharge of East Ditch 1	**SD-13** Rose Creek upstream of Collinsville Road	**SD-34** Shallow marsh discharge of West Ditch 1	**SD-22** Schoenberger Creek upstream of Collinsville Road	**SD-36** Schoenberger Creek at discharge of the Engineered Ditch	**SD-37** Schoenberger Creek downstream of discharge of the Engineered Ditch
Surface Water Chemistry										
Exceeds WQC	Ephemeral - zinc (chronic)	Ephemeral	Ephemeral - zinc (chronic)	None (ephemeral)	None (ephemeral)	Ephemeral - zinc (acute & chronic)	None	None	selenium (chronic)	None
Sediment Chemistry & Bioassay										
PEC-Q	11.0	2.57	24.5	3.80	32.2	9.95	31.5	1.31	0.63	1.27
Bioassay Survival	0		0	0	0	0	0		0	
Native Species Present during Bioassay	Yes		No	Yes	Yes	No			Yes	
Benthic Community Survey										
# Organisms	53	24 (1 sweep)	55	55	62	40	12	66	60	55
# Taxa	16	6	16	15	16	8	5	18	16	13
MBI	6.49	6	6.55	6.44	6.94	6	8.33	6.7	6.67	6.58
TBI	6.71	5	7.13	6.75	7.29	6	9	7	6.9	7
Benthic Tissue Chemistry										
Tissue LOEC TRV HQ										
Maximum HQ	0.62		0.92	0.78	2.54	0.73	1.14	0.68	0.6	0.52
Mean HQ	0.2		0.34	0.19	0.65	0.28	0.28	0.15	0.15	0.13

Blank cell indicates line of evidence not performed at location
HQ = Hazard quotient;LOEC = Lowest observed effect concentration, TRV = tissue residue effect level value, see Table 6-3
PEC-Q = Probable Effect Concentration Quotient; see Table 6-1.
MBI = Macroinvertebrate Biotic Index; See Table 5-6
TBI = Tolerance Biotic Index, see Table 5-6
Ephemeral indicates surface water body is ephemeral and channelized drainage feature
WQC = water quality criteria

Table 6-5
Maximum and Mean Hazard Quotients (HQ) for Estimated Benthic Invertebrate Tissue Concentrations[a] (excludes locations with measured tissue concentrations)
Old American Zinc Plant Site, Fairmont City, Illinois
Facility Drainage Ditch Investigative Samples

HQ = Hazard Quotient
LOEC = Lowest observed effect concentration
a = See Appendix F-2 for derivation of estimated tissue concentrations
b = See Appendix E for derivation of tissue residue effect levels

Facility Drainage Ditch Investigative Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-02-0.5	HQ= Tissue/LOEC	SD-07-0.5	HQ= Tissue/LOEC	SD-07-0.5/FD	HQ= Tissue/LOEC	SD-23-0.5	HQ= Tissue/LOEC	SD-23-0.5/FD	HQ= Tissue/LOEC	SD-24-0.5	HQ= Tissue/LOEC	SD-25-0.5	HQ= Tissue/LOEC	SD-25-0.5/FD	HQ= Tissue/LOEC	SD-26-0.5	HQ= Tissue/LOEC	SD-27-0.5	HQ= Tissue/LOEC	SD-28-0.5	HQ= Tissue/LOEC
Location		East Ditch 2		West Ditch 2		West Ditch 2		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1	
Cadmium	0.59	0.01575144	0.03	0.02428347	0.04	0.02428347	0.04	0.0853203	0.1	0.0787572	0.1	0.4134753	0.7	0.01772037	0.03	0.4266015	1	0.04200384	0.07	0.04003491	0.07	0.03347181	0.1
Lead	5.22	0.0889108	0.02	0.444354	0.09	0.363726	0.02	0.343519	0.07	0.363726	0.07	1.131592	[illegible]	0.666831	0.1	0.60621	0.1	0.1636767	0.03	0.1980286	0.04	0.1475111	0.01
Zinc	11.12	1.06713	0.1	19.56409	2	13.63558	1	8.2999	0.7	8.89275	0.8	23.714	2	4.03138	0.4	56.32075	5	12.44985	1	11.857	1	8.89275	0.1
	Mean HQ		0.05		0.6		0.4		0.3		0.3		1		0.2		2		0.4		0.4		0.07

Rose Creek Investigative Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-09-0.5	HQ= Tissue/LOEC	SD-41	HQ= Tissue/LOEC	SD-41-D	HQ= Tissue/LOEC	SD-42	HQ= Tissue/LOEC	SD-10-0.5	HQ= Tissue/LOEC	SD-11-0.5	HQ= Tissue/LOEC	SD-12-0.5	HQ= Tissue/LOEC	SD-12/FD	HQ= Tissue/LOEC	SD-43	HQ= Tissue/LOEC	SD-44	HQ= Tissue/LOEC
Location		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek	
Cadmium	0.59	0.069631	0.1	[illegible]	0.2	0.1115727	0.2	0.3347181	0.6	0.1181358	0.2	0.01603299	0.03	0.01837668	0.03	0.02559609	0.04	0.0853203	0.1	0.05184849	0.09
Lead	5.22	0.363726	0.07	0.824487	0.2	0.325382	0.1	0.545689	0.1	0.1737802	0.03	0.060621	0.01	0.0242484	0.005	0.0383933	0.01	0.1172096	0.02	0.1515525	0.03
Zinc	11.12	8.89275	0.8	18.37835	2	14.2264	2	7.71142	[illegible]	7.70705	0.7	2.84568	0.3	1.363555	0.1	2.01569	0.2	4.327805	0.4	3.142106	0.3
	Mean HQ		0.3		[illegible]		[illegible]		0.2		0.3		0.1		0.05		0.08		0.2		0.1

Rose Creek Upstream Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-03-0.5	HQ= Tissue/LOEC	SD-04-0.5	HQ= Tissue/LOEC	RSD-1	HQ= Tissue/LOEC	RSD-2	HQ= Tissue/LOEC	RSD-3	HQ= Tissue/LOEC	RSD-4	HQ= Tissue/LOEC
Location		Ditch along Kingshighway		Rose Creek (upstream)		Facility, east of Kingshighway & south of General Chemical		Facility, east of Kingshighway & south of General Chemical		Facility, west of Kingshighway & south of Former Swift Ag Chem		Facility, west of Kingshighway & south of Former Swift Ag Chem	
Cadmium	0.59	0.02493676	0.04	0.006497469	0.01	0.00328155	0.01	0.006497469	0.01	0.00328155	0.01	0.006497469	0.01
Lead	5.22	0.1164764	0.02	0.1565796	0.03	0.1252834	0.02	0.1576146	0.03	0.0767866	0.01	0.1273041	0.02
Zinc	11.12	2.312115	0.2	3.652135	0.3	0.4209233	0.04	0.770705	0.07	0.486137	0.04	0.94856	0.09
	Mean HQ		0.09		0.1		0.02		0.04		0.02		0.04

Rose Creek Outfall Investigative Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-14-0.5	HQ= Tissue/LOEC	SD-15-0.5	HQ= Tissue/LOEC	SD-16-0.5	HQ= Tissue/LOEC	SD-17-0.5	HQ= Tissue/LOEC	SD-18-0.5	HQ= Tissue/LOEC	TRC-2-S-0-6	HQ= Tissue/LOEC	TRC-2-S-8-10	HQ= Tissue/LOEC	TRC-2-S-12-14	HQ= Tissue/LOEC	TRC-2-S1-0-6	HQ= Tissue/LOEC
Location		Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed	
Cadmium	0.59	0.00787572	0.01	0.00459834	0.01	0.00721641	0.01	0.00984465	0.02	0.01706406	0.03	0.853203	1.45	1.378251	2.34	0.0918834	0.16	0.1903299	0.32
Lead	5.22	0.0868931	0.02	0.0464781	0.01	0.0666831	0.01	0.0323312	0.01	0.0424347	0.01	0.323312	0.06	0.424347	0.08	1.111385	0.21	0.242484	0.05
Zinc	11.12	0.652135	0.06	0.46875	0.04	0.482085	0.04	1.007845	0.09	0.4802085	0.04	8.89275	0.8	11.857	1.07	3.91281	0.35	5.09857	0.46
	Mean HQ		0.03		0.02		0.02		0.04		0.03		0.77		1.16		0.24		0.28

West Ditch Outfall Investigative Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-29-0.5	HQ= Tissue/LOEC	SD-30-0.5	HQ= Tissue/LOEC	SD-31-0.5	HQ= Tissue/LOEC	SD-32-0.5	HQ= Tissue/LOEC	SD-33-0.5	HQ= Tissue/LOEC	SD-38	HQ= Tissue/LOEC	SD-39	HQ= Tissue/LOEC	SD-40	HQ= Tissue/LOEC
Location		West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		Cahokia Watershed		Cahokia Watershed		Cahokia Watershed	
Cadmium	0.59	0.02822133	0.05	0.04725432	0.08	0.02428347	0.04	0.04528539	0.08	0.004531646	0.01	0.0918834	0.2	0.01640775	0.03	0.06497469	0.11
Lead	5.22	0.1767666	0.03	0.1037657	0.02	0.0160764	0.01	0.1758009	0.03	0.00928522	0.002	0.0687038	0.01	0.0484968	0.01	0.0383933	0.01
Zinc	11.12	2.2714	0.2	2.28283	0.2	4.663515	0.4	3.79424	[illegible]	0.3497815	0.03	8.2999	[illegible]	2.074975	0.2	5.276365	0.5
	Mean HQ		0.09		0.1		0.2		0.2		0.01		0.3		0.07		0.2

West Ditch Outfall Investigative Samples (continued)

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-45	HQ= Tissue/LOEC	SD-46	HQ= Tissue/LOEC	SD-47	HQ= Tissue/LOEC	SD-48	HQ= Tissue/LOEC	TWD-02-C-0-6	HQ= Tissue/LOEC	TWD-02-C-6-9	HQ= Tissue/LOEC	TWD-02-C-6-9 DUP	HQ= Tissue/LOEC	TWD-02-S-0-6	HQ= Tissue/LOEC	TWD-02-S-6-9	HQ= Tissue/LOEC
Location		Cahokia Wetland		Cahokia Wetland		Cahokia Wetland		Cahokia Wetland		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed	
Cadmium	0.59	0.03675336	0.06	0.04725432	0.08	0.1115727	0.2	0.05841159	0.1	0.04659801	0.08	0.01115727	0.02	0.00787572	0.01	0.0918834	0.2	0.02231454	0.04
Lead	5.22	0.444554	0.09	0.1162212	0.02	0.1848664	0.04	0.1353869	0.03	0.0424347	0.01	0.323312	[illegible]	0.0242484	0.005	0.0525382	0.01	0.0424347	0.01
Zinc	11.12	9.4856	0.9	13.63558	1	12.60123	1	15.4141	1	7.1142	0.6	1.126415	1	1.126415	0.1	9.4856	0.9	2.193545	0.2
	Mean HQ		0.3		0.4		0.5		0.5		0.2		0.04		0.04		0.3		0.08

West Ditch Outfall Reference Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	TWD-1-N-0-6	HQ= Tissue/LOEC	TWD-1-N-6-8	HQ= Tissue/LOEC	TWD-1-C-0-6	HQ= Tissue/LOEC	TWD-1-C-6-10	HQ= Tissue/LOEC	TWD-1-S-0-6	HQ= Tissue/LOEC	TWD-1-S-6-9.5	HQ= Tissue/LOEC	TWD-02-N-0-6	HQ= Tissue/LOEC	TWD-02-N-6-7	HQ= Tissue/LOEC	TWD-03-N-0-6	HQ= Tissue/LOEC	TWD-03-N-6-8	HQ= Tissue/LOEC	TWD-03-C-0-6	HQ= Tissue/LOEC	TWD-03-C-6-8.5	HQ= Tissue/LOEC	TWD-03-S-0-6	HQ= Tissue/LOEC	TWD-03-S-6-9	HQ= Tissue/LOEC	TWD-03-S-10-12	HQ= Tissue/LOEC
Location		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed	
Cadmium	0.59	0.03609706	0.06	0.02953671	0.05	0.02887764	0.05	0.01050796	0.02	0.0590679	0.10	0.00984465	0.02	0.02100192	0.04	0.02887764	0.05	0.01837668	0.03	0.01181358	0.02	0.01640775	0.03	0.01378251	0.02	0.01509613	0.03	0.0131262	0.02	0.01246989	0.02
Lead	5.22	0.0262691	0.01	0.0464624	0.01	0.01576146	0.003	0.0666831	0.001	0.0788073	0.02	0.01576146	0.003	0.0282898	0.01	0.0262691	0.01	0.0262691	0.01	0.01050764	0.002	0.0363726	0.01	0.0282898	0.01	0.0303175	0.01	0.01192215	0.002	0.00669936	0.002
Zinc	11.12	1.6857	0.1	2.274675	0.2	1.719265	0.15	1.06713	0.10	2.72711	0.2	1.06713	0.10	1.06713	0.1	1.06713	1	1.126415	0.1	0.71142	0.06	1.600695	0.1	0.770705	0.07	1.42284	0.13	0.770705	0.07	0.770705	0.7
	Mean HQ		0.06		0.1		0.07		0.04		0.1		0.04		0.05		0.05		0.05		0.03		0.06		0.03		0.06		0.02		[illegible]

Rose Creek Outfall Reference Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-50-0-6	HQ= Tissue/LOEC	SD-50-8-10	HQ= Tissue/LOEC	SD-51-DITCH-0-6	HQ= Tissue/LOEC	SD-51-DITCH-6-10	HQ= Tissue/LOEC	SD-51-DITCH-12-14	HQ= Tissue/LOEC	TRC-3-S-0-6	HQ= Tissue/LOEC	TRC-3-S-7-9	HQ= Tissue/LOEC
Location		Old Cahokia Creek		Old Cahokia Creek		Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed		Old Cahokia Watershed	
Cadmium	0.59	0.01443882	0.02	0.01443882	0.03	0.065631	0.1	0.2165823	0.4	0.04922325	0.08	0.02362716	0.04	0.04200384	0.07
Lead	5.22	0.01172106	0.002	0.01899164	0.004	0.969621	0.2	0.1313455	0.03	0.323312	0.06	0.01596353	0.003	0.00767866	0.001
Zinc	11.12	0.462425	0.04	0.652135	0.06	1.126415	0.1	1.837835	0.2	0.94856	0.09	0.652135	0.06	0.94856	0.09
	Mean HQ		0.02		0.03		0.07		0.2		0.08		0.03		0.06

Impoundment Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	TRC-1-N-0-6	HQ= Tissue/LOEC	TRC-1-N-6-8	HQ= Tissue/LOEC	TRC-1-S-0-6	HQ= Tissue/LOEC	TRC-1-S-0-6-D	HQ= Tissue/LOEC	TRC-1-S-6-8	HQ= Tissue/LOEC	TRC-2-N-0-6	HQ= Tissue/LOEC	TRC-2-N1-0-6	HQ= Tissue/LOEC	TRC-2-N1-6-8	HQ= Tissue/LOEC	TRC-2-C-0-6	HQ= Tissue/LOEC	TRC-2-C-10-12	HQ= Tissue/LOEC	TRC-3-N-0-6	HQ= Tissue/LOEC	TRC-3-N-0-6/FD	HQ= Tissue/LOEC	TRC-3-N-8-10	HQ= Tissue/LOEC
Location		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed		Old Cahokia Watershed	
Cadmium	0.59	0.00853203	0.01	0.00984971	0.02	0.00531611	0.01	0.004856694	0.01	0.004856694	0.01	7.21941E-05	0.0001	8.20388E-05	0.0001	9.5165E-05	0.0002	0.003150286	0.01	0.003170641	[illegible]	0.001315029	0.001	0.000065631	0.0001	8.20388E-05	0.0001
Lead	5.22	0.00267866	0.001	0.00424347	0.001	0.01515525	0.003	0.01454904	0.003	0.03343519	0.001	0.00181863	0.0003	0.00222277	0.0004	0.00242484	0.0005	0.00666831	0.001	0.00323312	0.001	0.001434697	0.0003	0.00181863	0.0003	0.000848694	0.0002
Zinc	11.12	0.403136	0.04	0.260934	0.02	0.48709	0.04	0.438709	0.04	0.414995	0.04	0.0225283	0.002	0.03142105	0.003	0.0320139	0.003	0.142284	0.01	0.04683515	0.004	0.01248997	0.002	0.02786395	0.003	0.01126415	0.001
	Mean HQ		0.02		0.01		0.02		0.02		0.02		0.001		0.001		0.001		0.01		0.002		0.001		0.001		0.0004

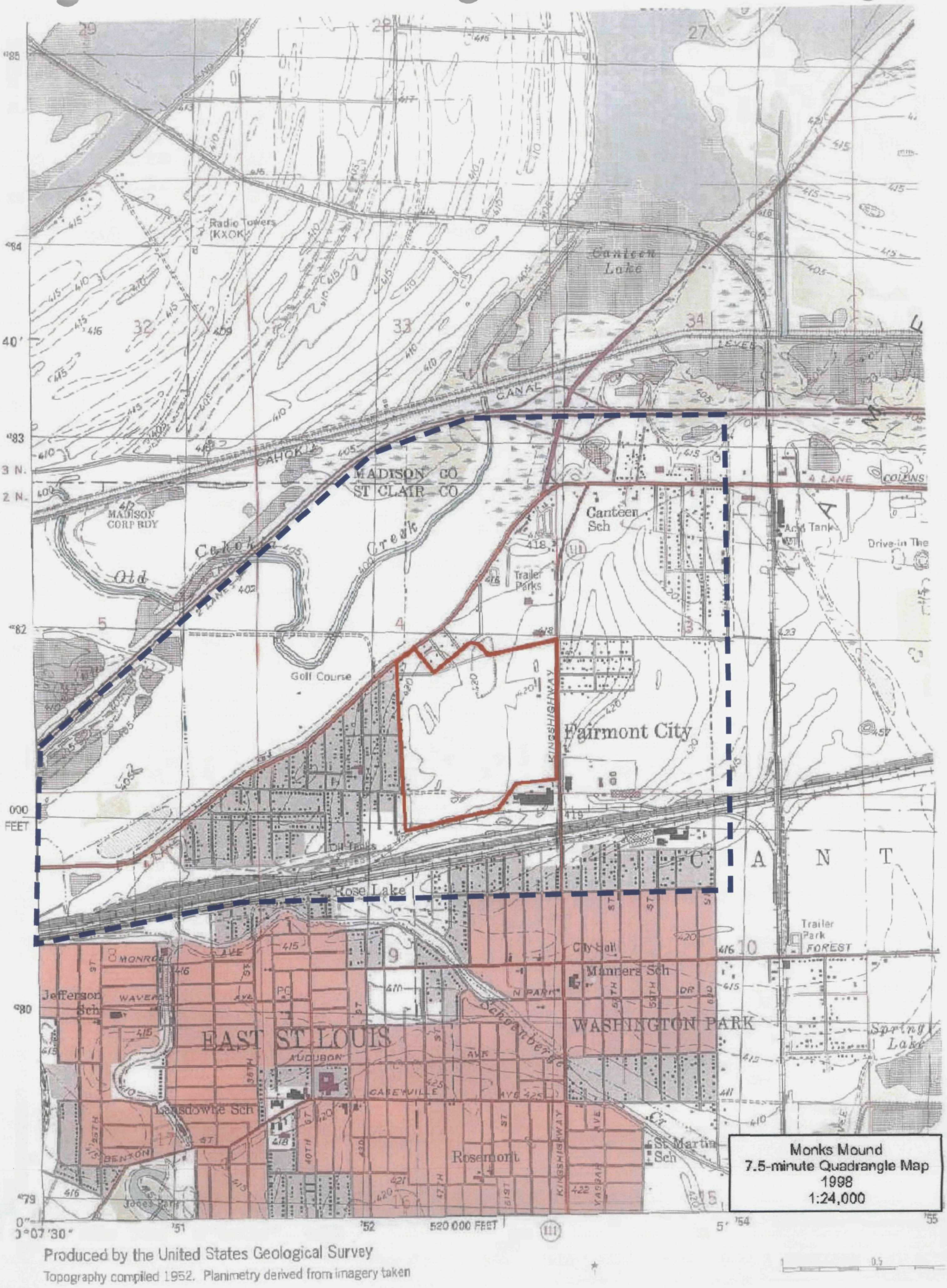
Schoenberger Creek Samples

Sample ID	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-20-0.5	HQ= Tissue/LOEC	SD-20-0.5/FD	HQ= Tissue/LOEC	SD-21-0.5	HQ= Tissue/LOEC	SD-52	HQ= Tissue/LOEC
Location		Sch. Creek		Sch. Creek		Sch. Creek		Schoenberger Creek - west of Old Cahokia western boundary	
Cadmium	0.59	0.01978513	0.03	0.01509613	0.03	0.01772037	0.03	0.0525382	0.09
Lead	5.22	0.0363726	0.01	0.0363726	0.006	0.0323312	0.006	0.0363726	0.007
Zinc	11.12	1.59265	0.15	0.5513565	0.05	0.580693	0.05	1.06713	0.1
	Mean HQ		0.06		0.03		0.03		0.06

ENTACT

Figures

Figures



Facility Area Boundary

Approximate Site Area Boundary

1) THE INFORMATION PRESENTED HEREIN IS CONFIDENTIAL IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.

ENTACT & ASSOCIATES, LLC		ENTACT	AMERICAN ZINC RIFS FAIRMONT CITY, ILLINOIS		
			FACILITY AREA AND SITE LOCATION MAP		
		DESIGNED BY	PAT	1/16/08	CHECKED BY PAT 1/16/08
		DRAWN BY	MMC	1/16/08	APPROVED BY PAT 1/16/08
DATE BY CHK'D APPR'D	REVISIONS NO.	SCALE 1":0.5MI	PROJECT NO. C-1727	FIGURE 1	REVISION NO. ---

1. THE INFORMATION PRESENTED HEREIN IS CONFIDENTIAL IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.
2. 2005 ORTHO-RECTIFIEDAERIAL PHOTOGRAPHY PROVIDED BY SURDEX, CHESTERFIELD, NO.

SCALE

0' 800' 1600'

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION
0	06/07/06	MMC	PT	PT	ISSUED FOR DRAFT RI REPORT

ENTACT
1010 EXECUTIVE COURT, Suite 280
WESTMONT, ILLINOIS 60559
P: 630-986-2900 F: 630-986-0653

DRAWING NAME: SITE AREA DRAINAGE

PROJECT NAME & LOCATION: AMERICAN ZINC RIFS, FAIRMONT CITY, ILLINOIS

DRAWN BY	M. CARLSON	APPROVED BY	P. THOMSON	REVISION	SHEET NO.
DATE	01-16-06	DATE	01-16-06	0	1 OF 1
PROJECT NO.	C1727	FIGURE NO.	2		

1. THE INFORMATION PRESENTED HEREIN IS CONFIDENTIAL IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.
2. 2005 ORTHO-RECTIFIEDAERIAL PHOTOGRAPHY PROVIDED BY SURDEX, CHESTERFIELD, NO.

SCALE

0' 800' 1600'

LEGEND

▲ SD-CT-01 BIOASSAY SAMPLE LOCATION

● PT-SD-31 PLANT TISSUE SAMPLE LOCATION

▬ BT-CT-01 BENTHIC MACRO-INVERTEBRATE TISSUE SAMPLE LOCATION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION
0	08/07/06	MMC	PT	PT	ISSUED FOR DRAFT RI REPORT

ENTACT
1010 EXECUTIVE COURT, Suite 280
WESTMONT, ILLINOIS 60559
P: 630-986-2900 F: 630-986-0653

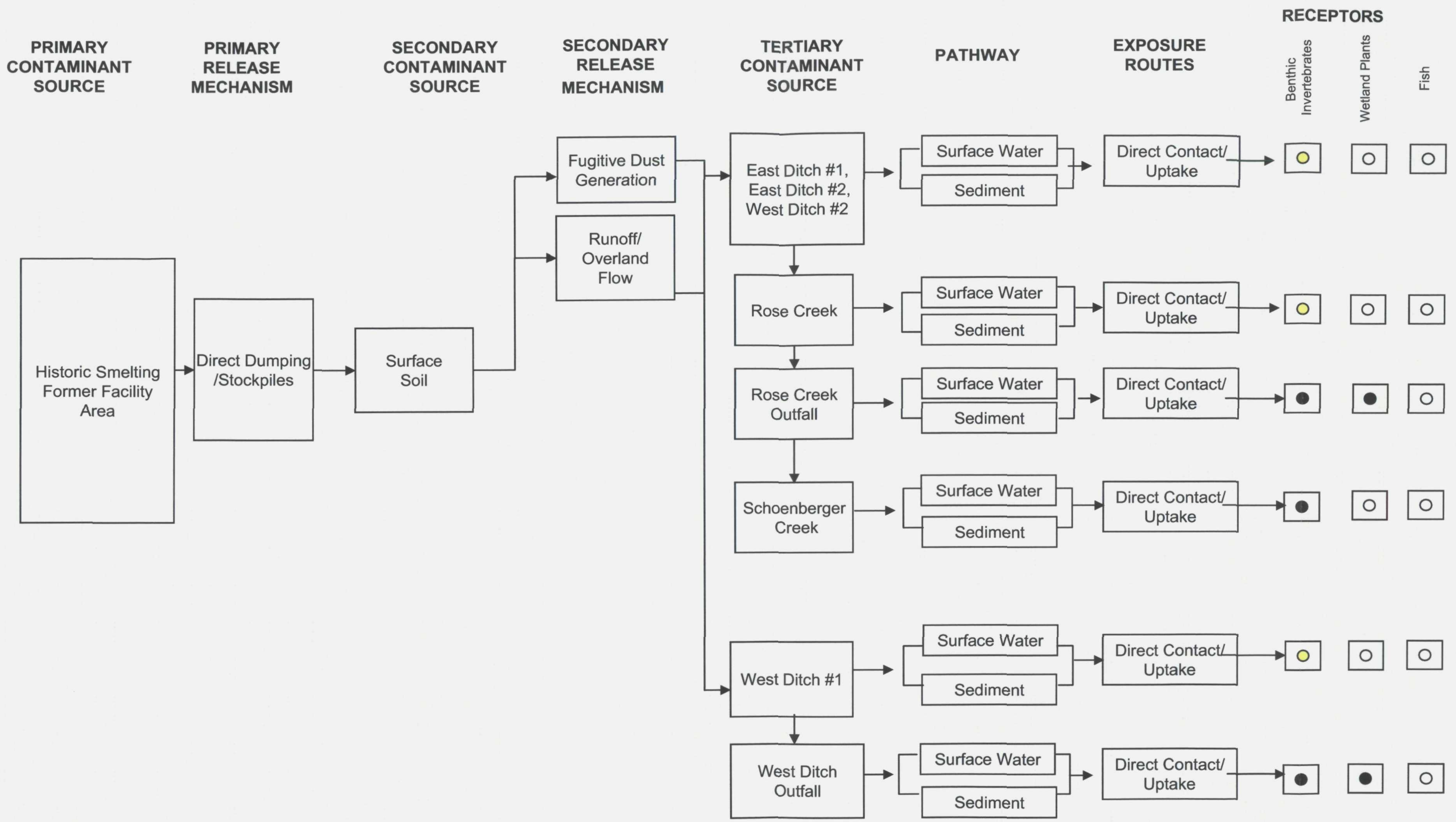
DRAWING NAME

ECOLOGICAL SAMPLING LOCATIONS

PROJECT NAME & LOCATION

AMERICAN ZINC RIFS
FAIRMONT CITY, ILLINOIS

DRAWN BY	M. CARLSON	APPROVED BY	P. THOMSON	REVISION	SHEET NO.
DATE	01-16-06	DATE	01-16-06	0	1 OF 1
PROJECT NO.	C1727	FIGURE NO.	3		



Notes:

● = Medium to High Potential for Exposure; evaluated in BERA

○ = Identified as Incomplete Exposure

○ = Ephemeral, channelized drainage; limited aquatic habitat provided.

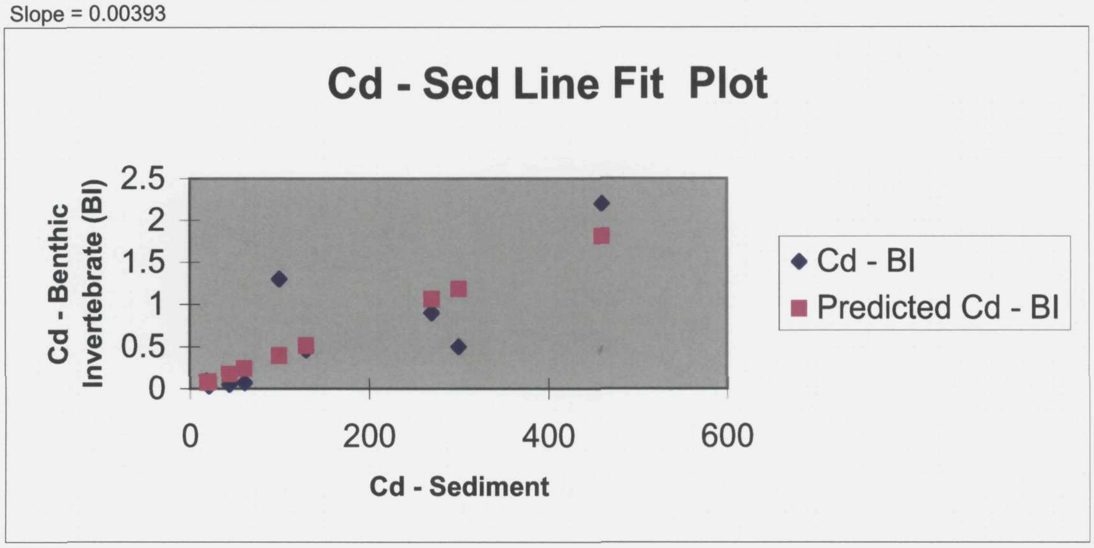
Fish were not observed in any of the sampled waterbodies.

Figure 4: Ecological Conceptual Site Model
Baseline Ecological Risk Assessment
Former Old American Zinc Plant Site

Figure 5
Regression Analysis of Benthic Tissue and Sediment Concentrations

R2 = 0.8066
P-value = 0.00042
Slope = 0.00393

254.4529262



R2 = 0.6149
Slope = 0.00121
P-value = 0.00725

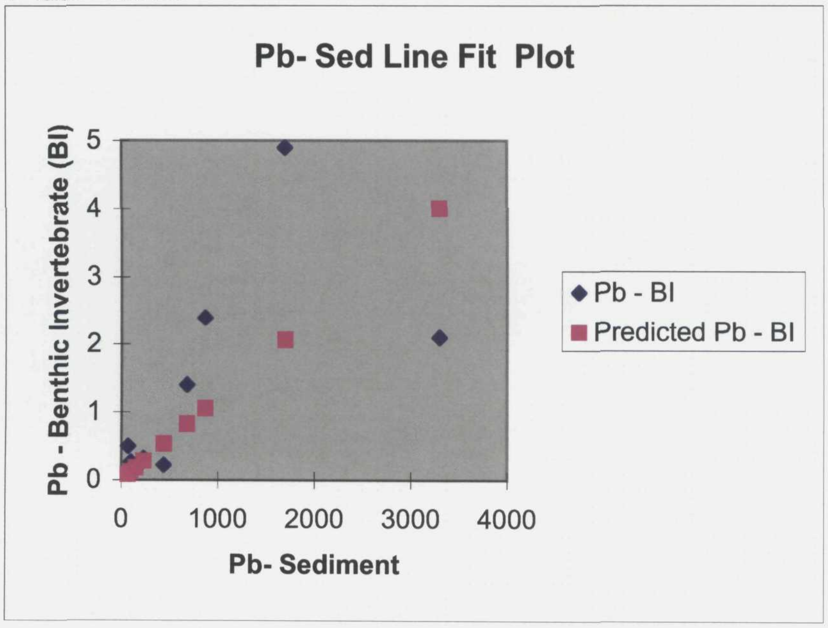
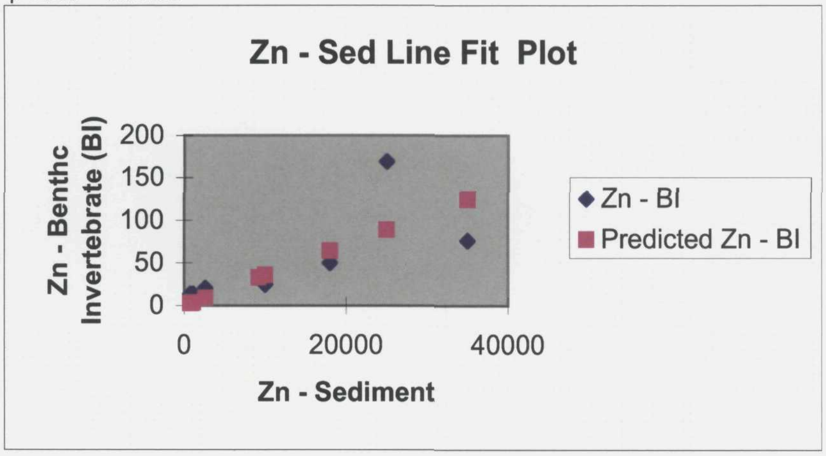


Figure 5 (continued)
Regression Analysis of Benthic Tissue and Sediment Concentrations

R2 = 0.759
Slope = 0.00355
p-value = 0.00103



ENTACT

ATTACHMENTS

ATTACHMENT A

SITE PHOTOGRAPHS

PHOTOGRAPH:	1	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 0745		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Mid section of East Ditch #2, facing east.		

PHOTOGRAPH:	2	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 0745		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Mid section of East Ditch #2, facing west.		

PHOTOGRAPH:	3	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006	0745	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Mid section of East Ditch #2, east of Photo #1 location, facing east.		

PHOTOGRAPH:	4	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006	0845	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, south of confluence with East Ditch #2. Sample location SD-CT-06, macro invertebrate survey/sampling.		

PHOTOGRAPH:	5	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 28, 2006	0845	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, south of confluence with East Ditch #2. Sample location SD-CT-06.		

PHOTOGRAPH:	6	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 28, 2006	0935	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1. Sample location SD-CT-01, facing south.		

PHOTOGRAPH:	7	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 0935		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1. Sample location SD-CT-01, facing NE.		

PHOTOGRAPH:	8	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 1020		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, immediately SE of East Ditch #2 confluence. Sample location SD-CT-05 . Facing south.		

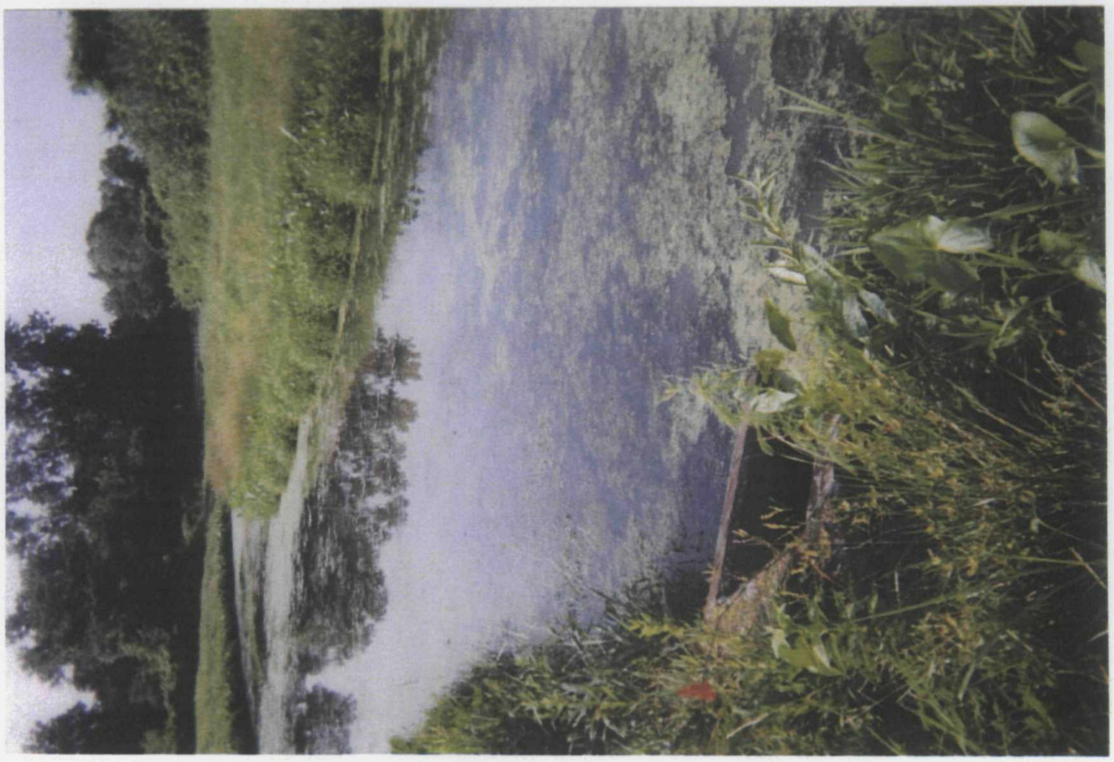
PHOTOGRAPH:	9	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 1100		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Rose Creek, along south side of site. Sample location SD-CT-08, facing SE.		

PHOTOGRAPH:	10	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 28, 2006 1100		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Rose Creek, along south side of site. Near sample location SD-CT-08, facing west.		

PHOTOGRAPH:	11	PHOTOGRAPHER:	Rhonda Regester
DATE/TIME:	June 28, 2006 1545		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Old Cahokia Creek watershed, west of West Ditch Outfall. East of sample location SD-C-034 (at edge of open water), facing west.		

PHOTOGRAPH:	12	PHOTOGRAPHER:	Rhonda Regester
DATE/TIME:	June 28, 2006 1545		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Old Cahokia Creek watershed, west of West Ditch Outfall. At sample location SD-CT-034, facing east.		

PHOTOGRAPH:	13	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006 0850		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Schoenberger Creek, at west outfall of Old Cahokia Creek watershed to north. Sample location SD-CT-36.		



PHOTOGRAPH:	14	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006 0850		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Schoenberger Creek, at west outfall of Old Cahokia Creek watershed to north. Sample location SD-CT-36. Facing ENE.		

PHOTOGRAPH:	15	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 29, 2006 0935		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Schoenberger Creek, downstream of west outfall of old Cahokia Creek watershed. Sample location SD-CT-37, facing NW.		

PHOTOGRAPH:	15	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 29, 2006 0935		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Schoenberger Creek, downstream of west outfall of Old Cahokia Creek watershed. Sample location SD-CT-37, facing NE.		

PHOTOGRAPH:	17	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, near sample location SD-CT-01, looking south.		

PHOTOGRAPH:	18	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, roughly 200 feet SSW of sample location SD-CT-091, looking SSW		

PHOTOGRAPH:	19	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, roughly 300 feet SSW of sample location SD-CT-091, looking SSW		

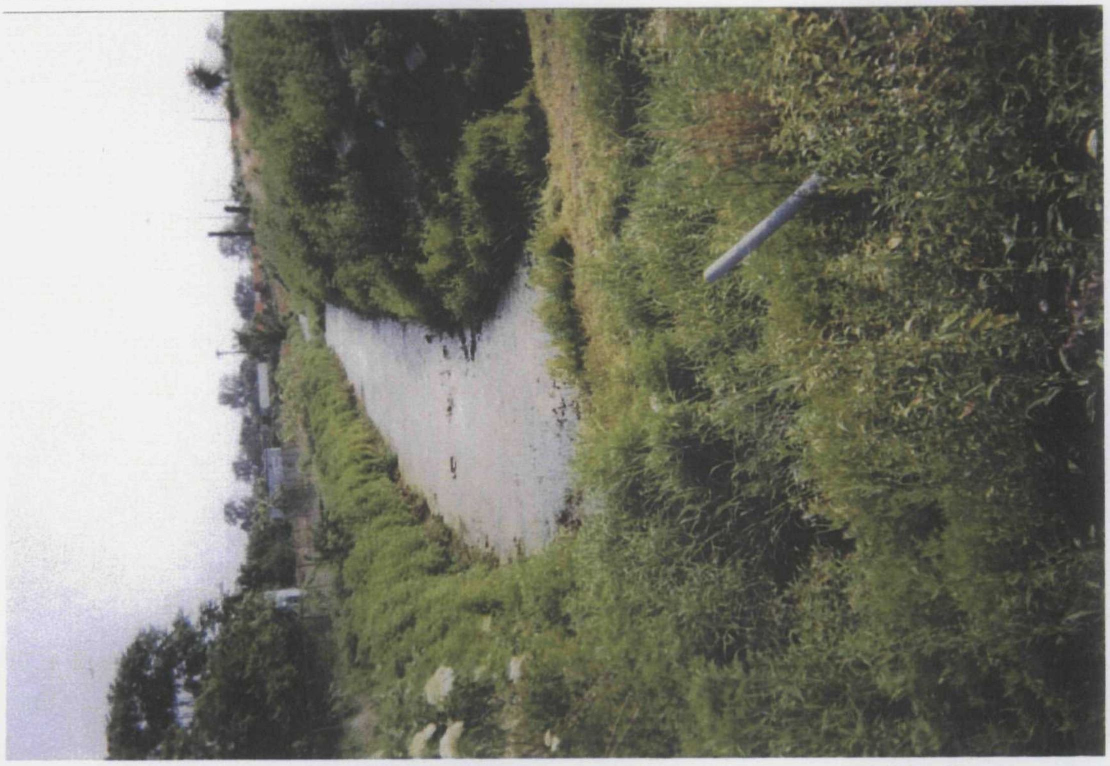
PHOTOGRAPH:	20	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at culvert approximately 750 feet SSW of sample location SD-CT-01, looking NNE.		

PHOTOGRAPH:	21	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at culvert approximately 750 feet SSW of sample location SD-CT-01, looking SSW.		

PHOTOGRAPH:	22	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006	Approx. 1650	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at culvert approximately 250 feet NNE of confluence with East Ditch #2, looking NNE.		

PHOTOGRAPH:	23	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006 Approx. 1650		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at culvert approximately 250 feet NNE of confluence with East Ditch #2, looking south.		

PHOTOGRAPH:	24	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at north end of culvert immediately north of confluence with East Ditch #2, looking NNE.		

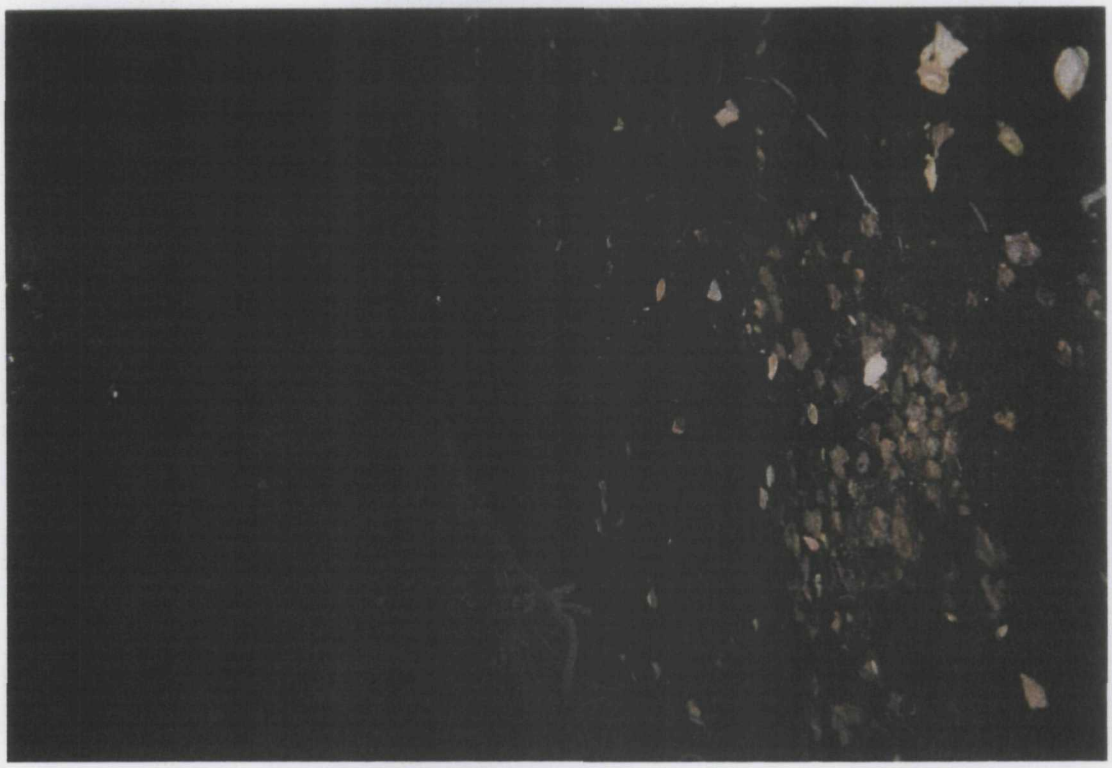


PHOTOGRAPH:	25	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006 Approx. 1650		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at south end of culvert at confluence with East Ditch #2, looking SW. Sample location SD-CT-05 in mid-photo.		

PHOTOGRAPH:	26	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 29, 2006		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	East Ditch #1, at culvert at confluence with East Ditch #2, looking east at East Ditch #2.		

PHOTOGRAPH:	27	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 0815		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Snapping turtle in Rose Creek near bioassay sample point SD-CT-013.		

PHOTOGRAPH:	28	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 0830		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Collecting bioassay sample at location SD-CT-013 in Rose Creek.		



PHOTOGRAPH:	29	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006	0850	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Bioassay sample at location SD-CT-013 in Rose Creek.		

PHOTOGRAPH:	30	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006	1150	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Open area between West Ditch outfall and Old Cahokia Creek Watershed pond. Approx.160 feet NNW of outfall, facing NNW.		

PHOTOGRAPH:	31	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 1150		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Approximately 160 feet NNW of West Ditch outfall, looking SSE.		

PHOTOGRAPH:	32	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 1200		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study reference site. Storm water culvert on north side of Collinsville Road.		

PHOTOGRAPH:	33	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006	1210	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study reference site. Approx. 140 feet W of culvert, facing NNW.		

PHOTOGRAPH:	34	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006	1210	
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study reference site. Approx. 140 feet W of culvert, facing north.		

PHOTOGRAPH:	35	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 1210		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study reference site. Approx. 140 feet W of culvert, facing ESE. Culvert is at base of large tree in center-left of photo.		

PHOTOGRAPH:	36	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. Approx. 150 feet N of outfall, facing N.		

PHOTOGRAPH:	37	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. Drum carcasses along flow path roughly 200 feet NNW of outfall.		

PHOTOGRAPH:	38	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. View of flow path between two study transects, NNW of outfall.		

PHOTOGRAPH:	39	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. View of flow path between two study transects, NNW of outfall.		

PHOTOGRAPH:	40	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. Transect study area approx. 300 feet NNW of outfall, facing NNW		

PHOTOGRAPH:	41	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	June 30, 2006 Approx. 1225		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Plant community study site at Rose Creek outfall. Transect study area approx. 300 feet NNW of outfall, facing NNW		

PHOTOGRAPH:	42	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1105		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-45 in wet meadow downgradient of West Ditch Outfall. Looking NW.		

PHOTOGRAPH:	43	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1105		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-45 in wet meadow downgradient of West Ditch Outfall. Looking SE (outfall point in background).		

PHOTOGRAPH:	44	PHOTOGRAPHER:	Mike Carlson
DATE/TIME:	December 12, 2006 1115		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Collecting sediment sample at location SW/SD-38, at southern edge of open water in Cahokia wetlands complex. Looking NW.		

PHOTOGRAPH:	45	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1125		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample at location SW/SD-39, at southern edge of open water in Cahokia wetlands complex. Looking NW.		

PHOTOGRAPH:	46	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1125		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample at location SW/SD-39, at southern edge of open water in Cahokia wetlands complex. Looking NW.		

PHOTOGRAPH:	47	PHOTOGRAPHER:	Mike Carlson
DATE/TIME:	December 12, 2006 1135		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Collecting sediment sample at location SW/SD-40, at southern edge of open water in Cahokia wetlands complex. Looking N.		

PHOTOGRAPH:	48	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1350		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-41, Rose Creek at confluence with West Ditch, SW corner of Site. Rose Creek culvert under access point to CSX terminal in background. Looking ENE.		

PHOTOGRAPH:	49	**PHOTOGRAPHER:**	Mike Carlson
DATE/TIME:	December 12, 2006 1445		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-43, Rose Creek roughly 230 feet upstream (SE) of Collinsville Road.		

PHOTOGRAPH:	50	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 12, 2006 1445		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-43, Rose Creek roughly 230 feet upstream (SE) of Collinsville Road. Looking W.		

PHOTOGRAPH:	51	**PHOTOGRAPHER:**	Mike Carlson
DATE/TIME:	December 12, 2006 1445		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Sample location SW/SD-43, Rose Creek approximately 230 feet upstream (SE) of Collinsville Road. Looking W.		

PHOTOGRAPH:	52	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 14, 2006 0910 - 0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow between West Ditch outfall and open water of Cahokia wetlands complex. Near outfall, looking NW.		

PHOTOGRAPH:	53	**PHOTOGRAPHER:**	Mike Carlson
DATE/TIME:	December 14, 2006 0910-0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow by West Ditch outfall, looking NW. Panorama with photos 54, 55 and 56.		

PHOTOGRAPH:	54	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	December 14, 2006 0910 - 0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow north of West Ditch outfall, looking WNW. Flag for sample SW/SD-45 in left foreground. Panorama with photos 53, 55 and 56.		

PHOTOGRAPH:	55	PHOTOGRAPHER:	Mike Carlson
DATE/TIME:	December 14, 2006 0910-0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow north of West Ditch outfall, looking WSW. Flag for sample SW/SD-45 in rightt foreground. Panorama with photos 53, 54 and 56.		

PHOTOGRAPH:	56	PHOTOGRAPHER:	Jeff Stofferahn
DATE/TIME:	December 14, 2006 0910 - 0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow north of West Ditch outfall, looking SSW. Panorama with photos 53, 54 and 55.		

PHOTOGRAPH:	57	PHOTOGRAPHER:	Mike Carlson
DATE/TIME:	December 14, 2006 0910-0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Edge of open water in Cahokia wetalnds complex, downgradient from West Dicth Outfall. Duck blind in center of photo. Looking NNW		

PHOTOGRAPH:	58	**PHOTOGRAPHER:**	Jeff Stofferahn
DATE/TIME:	December 14, 2006 0910-0920		
PROJECT:	Old American Zinc Plant Site, Fairmont City, Illinois - RI/FS		
SUBJECT:	Wet meadow, looking NW approx. halfway between West Dicth outfall and open water of Cahokia wetlands complex.		

PHOTO	59	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME: 1020	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-N, looking northeast.		

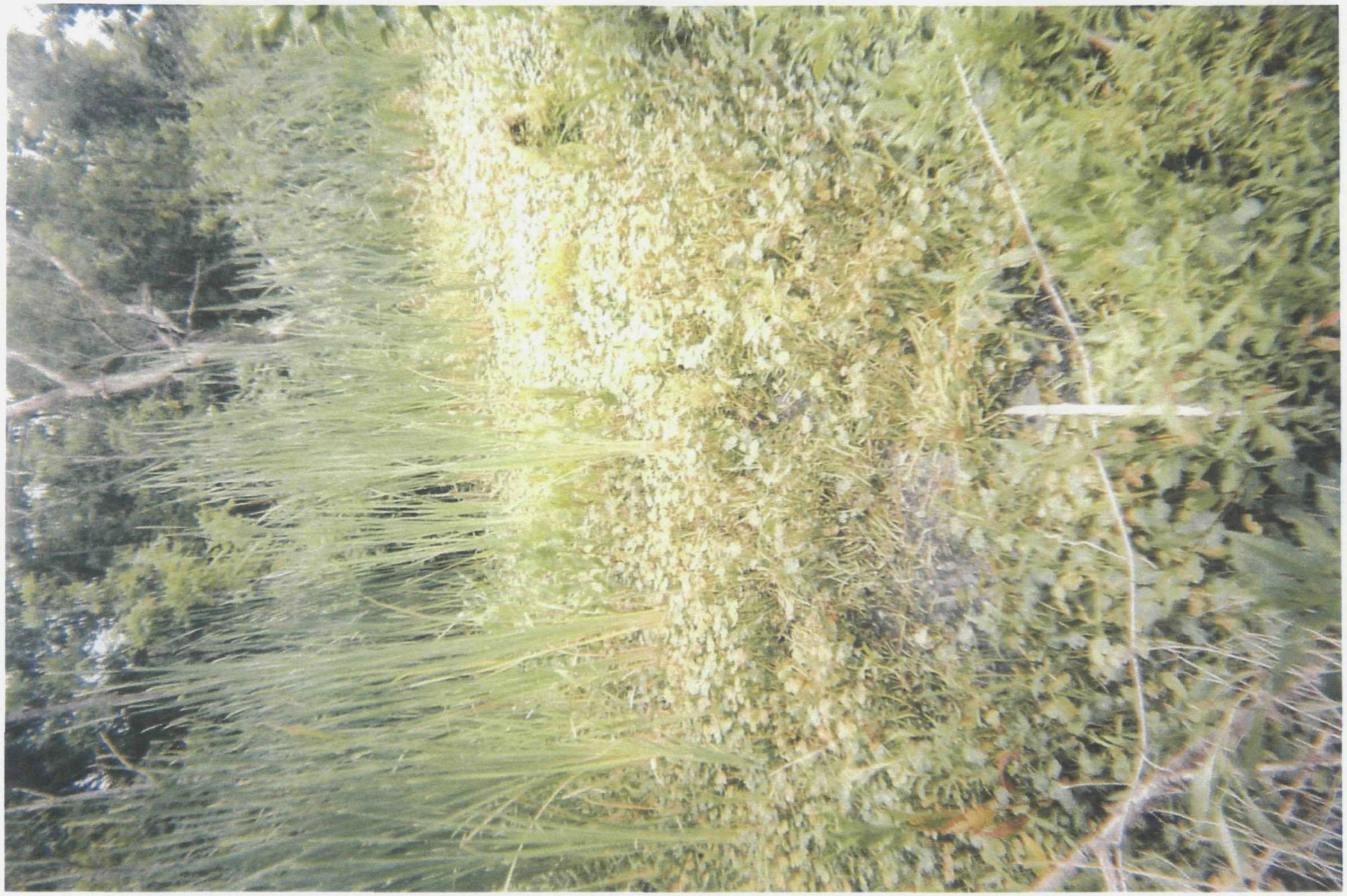


PHOTO	60	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1020
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-N, looking northeast.		

PHOTO	61	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1020
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-N, looking south-southwest.		

PHOTO	62	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1020
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-N, looking northwest		

PHOTO	63	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1105
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-C, looking southeast.		

PHOTO	64	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1105
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-C, looking southeast.		

PHOTO	65	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1105
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-C, looking northwest.		

PHOTO	66	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1105
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-C, looking northeast.		

PHOTO	67	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1105
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-C, looking northeast.		

PHOTO	68	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME: 1125	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-S, looking southeast.		

PHOTO	69	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1125
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-1-S, looking northwest.		

PHOTO	70	PHOTOGRAPHER: Rhonda Regester	
DATE:	July 17, 2007	TIME:	1455
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Collecting sediment sample TWD-2-S, looking northwest.		

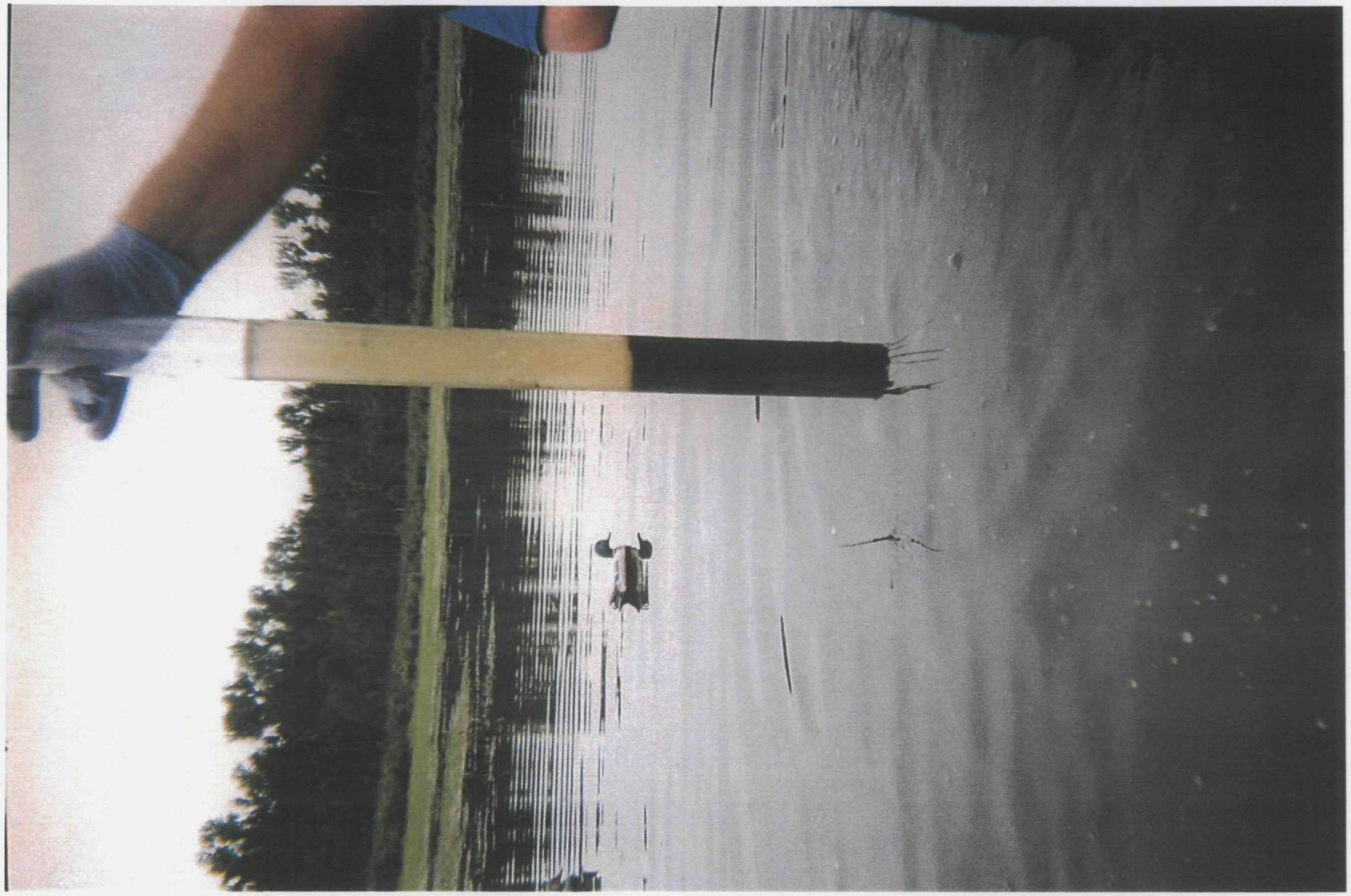


PHOTO	71	PHOTOGRAPHER: Rhonda Regester	
DATE:	July 17, 2007	TIME: 1455	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Sediment sample TWD-2-S. Note decoys on water.		

PHOTO	72	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1455
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-2-S., looking southeast. Note remnants of old duck blinds.		

PHOTO	73	PHOTOGRAPHER: Rhonda Regester	
DATE:	July 17, 2007	TIME:	1515
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-2-C, looking north-northwest.		

PHOTO	74	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1515
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-2-C, looking northwest.		

PHOTO	75	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1535
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-2-N, looking east-southeast.		

PHOTO	76	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1535
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS.		
SUBJECT:	Location of sediment sample TWD-2-N, looking northwest.		

PHOTO	77	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1600
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-3-S, looking northeast.		

PHOTO	78	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME: 1600	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-3-S, looking southwest.		

PHOTO	79	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME:	1600
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS.		
SUBJECT:	Wooded area to southeast of sediment sample TWD-3-S.		

PHOTO	80	PHOTOGRAPHER: Jeff Stofferahn	
DATE:	July 17, 2007	TIME: 1635	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS.		
SUBJECT:	Location of sediment sample TWD-3-N, looking northwest.		

PHOTO	81	PHOTOGRAPHER: Rhonda Regester	
DATE:	July 17, 2007	TIME: 1635	
SITE:	Former American Zinc Site, Fairmont City, Illinois-RI/FS		
SUBJECT:	Location of sediment sample TWD-3-N, looking southeast.		

ATTACHMENT B

BIOASSAY LABORATORY RESULTS

M

Peter G. Meier
514 Christine Drive
Ann Arbor, MI 48103

August 4, 2006

Pat Thomson
ENTACT
1010 Executive Center St, #280
Westmont, IL 60559

Dear Ms. Thomson:

Please find attached a copy of the invoice for this work and a report. Please review and if you have any questions, you may either E-mail (pgmeier@umich.edu) or call me at (734) 717-3013. Thank you kindly.

Sincerely yours,

Peter G. Meier

Peter G. Meier, PhD.

Whole Aquatic Sediments Evaluation

Employing the Dipteran, *Chironomus tentans*

July 6 – 17, 2006

Prepared for:

ENTACT & Associates LLC
1010 Executive Court, Suite 280
Westmont, *IL 60559*

By

Peter G. Meier, Ph.D.
Tui B. Minderhout, Ph.D.

Aquatic Toxicology and Microbiology Laboratory
331 Metty Drive, Suite #1
Ann Arbor, MI 48103

August 7, 2006

1. INTRODUCTION

This report contains whole-sediment toxicity evaluations performed on sediment during July, 2006. The purpose of the tests was to determine the potential acute toxicity of sediment contaminants on the dipteran, *Chironomus tentans*. This report outlines procedures specific for sediment toxicity testing and data evaluation. This work was carried out at the Aquatic Toxicology and Microbiology Laboratory in Ann Arbor, Michigan.

2. PROCEDURES AND METHODS

The evaluation of the toxicity of eight sediments was conducted using the ten day survival test for the dipteran, *C. tentans*. The procedures followed are contained in EPA/600/R-99/064, *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates.* A summary of a recommended test conditions for the midge is found in Table 1.

2.1 Laboratory Water Supply

A moderately hard water for *C. tentans* cultures and maintenance is employed in our facility. Preparation of the reconstituted moderately hard laboratory water is outlined in EPA/821/R-02-013. This water is made up in a volume of 200 L on which water quality parameters are run to check for consistencies between batches. This moderately hard water was utilized as the culture water as well as for the overlying water renewal.

2.2 Test Organisms

The test organisms, *C. tentans*, were obtained from Aquatic Biosystem, Inc. in Fort Collins, Colorado. A sufficient number of midges were shipped to the laboratory on June 29, 2006 and upon arrival were immediately transferred to a 10 L aerated aquarium until their use. They were fed a homogenized Tetrafin® goldfish mixture until test exposure initiation on July 7, 2006.

2.3 Sediment Collection and Source

Seven of the eight sediments were collected by ENTACT/STL personnel from the vicinity of Fairmont City, Illinois from June 28, 2006 to June 30, 2006. The samples were shipped in coolers with ice to the laboratory and stored at 4°C in the refrigerator. A control sediment was prepared from shredded brown paper toweling that was soaked for 24 hours in acetone. It was rinsed five times with deionized water. After that step, the shredded paper was placed in a 10 L aquarium and aerated for four days. Part of the shredded substrate was employed as the control sediment, whereas the remainder was frozen for future use.

2.4 Experimental Design

The aim of these tests was to evaluate the potential acute toxicity of the seven sediments and one laboratory control. With this objective in mind, standard testing procedures, as summarized in Table 1, were employed. Eight replicates per sediment were set up for *C. tentans* exposures and the shredded paper toweling that was used in maintaining laboratory culture, was employed as a control sediment. Moderately hard laboratory water was utilized for the overlying water.

One day prior to the start of the test (day -1) the sediment from each site was mixed thoroughly and the 100 mL aliquots were transferred to each of the eight test chambers. During this process, large debris that consisted mostly of partially decaying plant material and visible fauna were removed. Visual observations of the sediments that were made at that time are noted in Table 2. Moderately hard laboratory water was also added at this time. On day 0, the overlying water was renewed before the test organisms were introduced into each of the glass beakers. Measurement of water quality parameters was also initiated on this day. Ten second- and early third-instar *C. tentans* larvae (10-12 days old) were randomly added to respective test chambers. At this time the organisms were fed, 1.5 mL homogenized Tetrafin® goldfish food. The glass beakers were placed in a rack and transferred to a temperature controlled incubator (23 ± 1°C.) The light cycle was 16 hours on and 8 hours off. Twice daily, temperature, conductivity, pH and dissolved oxygen were measured in the composite water sample derived from the eight replicates for each sediment treatment. After that process, the overlying water was renewed in all the beakers (Appendix A: Table A-1). Feeding occurred only after the morning renewal. This procedure was repeated daily through day 10, at which point the tests were terminated. On day 0, the overlying water from the beakers was composited from each sediment sample and 250 mL were retained for alkalinity, hardness and 500 mL for ammonia analysis. On the last day, the same procedure was followed. On day 10, the sediments were sieved through a #40 (425 μm) U.S. Standard mesh sieve and the surviving test organisms were removed and counted (Table A-2).

TABLE 1 RECOMMENDED TEST CONDITIONS FOR A TEN DAY SEDIMENT TOXICITY TEST WITH *CHIRONOMUS TENTANS*

1.	Test Type:	Whole-sediment toxicity test with renewal of overlying water
2.	Temperature (°C):	23 ± 1°C
3.	Light quality:	Wide-spectrum fluorescence lights
4.	Illuminance:	About 100 to1,000 lux
5.	Photoperiod:	16 h light, 8 h darkness (recommended)
6.	Test chamber size:	300 mL high form lipless beaker
7.	Sediment volume:	100 g
8.	Overlying water volume	175 mL
9.	Renewal of overlying water:	2 volume additions per day; continuous or intermittent (e.g. one volume addition every 12 hours)
10.	Age of test organisms:	Second- to third-instar (about 10-d-old larvae). All organisms must be second- or third-instar with at least 50% of the organisms at third-instar.
11.	No. of organisms per test chamber:	10
12.	No. replicate chambers per treatment:	Depends on the objective of the test. Eight replicates are recommended for routine testing.
13.	Feeding regime:	Tetrafin® goldfish food, fed 1.5 mL daily to each test chamber (1.5 mL contains 4.0 mg of dry solids)
14.	Aeration:	None, unless dissolved oxygen in overlying water drops below 40% of saturation
15.	Overlying water:	Culture water, well water, surface water, site water or reconstituted water
16.	Overlying water quality:	Hardness, alkalinity and ammonia measured at the beginning and end of a test. Temperature, pH, conductivity, and dissolved oxygen measured twice daily.
17.	Test duration:	10 days
18.	Endpoints	Survival, with greater than 70% in the control and with minimum mean ash free dry weight of 0.48 mg/ surviving control organism.

Test Method 100.2 EPA Publication 600/R-99/064 (March, 2000).

TABLE 2 PHYSICAL APPEARANCES OF SEDIMENTS COLLECTED DURING JUNE 28-30, 2006 PROXIMAL TO FAIRMONT CITY, ILLINOIS

SEDIMENT IDENTIFICATION	DESCRIPTION
Laboratory Control	Shredded brown paper toweling.
SD-CT-01 (Field Control)	Dark clayey loam with decaying vegetation, no odor, no oily sheen, oligochaetes and three midges were removed.
SD-CT-05	Dark brownish clay with decaying vegetation, no odor or oily sheen, rust-iron layer, no macroinvertebrates were observed.
SD-CT-06	Dark clayey loam with decaying vegetation, no odor or oily sheen, oligochaetes and two midges were removed.
SD-CT-08	Black clayey silt with decaying vegetation, no odor or oily sheen, some oligochaetes were removed.
SD-CT-13	Grayish clay silt, less vegetation, no odor or oily sheen, no macroinvertebrates were found.
SD-CT-34	Black clay with duck weed (*Lemna sp.*) and other vegetation, no odor or oily sheen, some oligochaetes were found.
SD-CT-36	Black clay with big pieces of twigs and some decaying vascular plant material, no odor or oily sheen, a few oligochaetes were removed.

Other indigenous species in the sediment, mostly aquatic worms, were also removed but not included in the survival count. The biological endpoint for these sediment tests was mortality. The validity of the test was based on greater than 70% survival in the control treatment for *C. tentans* and a mean ash free dry weight greater than 0.48 mg per surviving individual. In addition, it was recommended that the hardness, alkalinity, pH and ammonia in the overlying water within the treatments should not have varied by more than 50% over the test duration.

2.5 Statistical Analysis

Survival data for the tests were analyzed first for normality and homogeneity of the variance employing Shapiro-Wilk's and Bartlett's Tests, if necessary the data were transformed prior to the analysis. The Tox Stat® version 3.5 Program (University of Wyoming and West, Inc., WY) was employed for the statistical analysis. However, no statistical procedure was performed in this evaluation since an inadequate number of midges survived in all the sediments with the exception of the laboratory negative control (Table A-2).

2.6 Quality Assurance

The purpose of this experiment is important for two reasons. First of all, a reference test will monitor over time the relative sensitivity of the laboratory organisms. Results of the respective EC_{50} value for an acute test will provide information on physiological changes that affect tolerances. Secondly, the reference test is part of the QA/QC program that provides a tool to evaluate the ability of the laboratory to generate reproducible results (Appendix B).

3.0 RESULTS AND DISCUSSION

The toxicity evaluation of a control and seven grab aquatic sediment samples was initiated on July 7, 2006 and completed on July 17, 2006. The samples were collected from the vicinity of Fairmont City, IL by ENTACT/STL personnel.

3.1 Physical-Chemical Aspects

Temperature, conductivity, pH and dissolved oxygen were measured in the overlying water twice daily (Table A-1). The temperature stayed fairly constant and remained within the 23 ± 1°C guidelines. This was expected since the exposure vessels were kept in the temperature and light controlled incubator. For conductivity, the observed and recorded values varied somewhat between the 10 days exposure period and between sediment samples. But, a decreasing trend was noticed between the initial and final measurement for each of the overlying water taken from the respective sediment samples. A very similar pattern was observed with pH between days and sediment samples. However, an overall trend for decreasing pH values for all sediments was not the case. In some overlying water of the sediments, the pH decreased over the exposure period (laboratory control, SD-CT-06 and SD-CT-13); while the overlying waters from sediment SD-CT-01, SD-CT-05, SD-CT-08 and SD-CT-34 showed a slight increase in pH. For sediment SD-CT-36, no change between initial and final pH measurement was seen. The dissolved oxygen concentration also varied somewhat but stayed above the 40% saturation level as recommended. A slight increasing trend with time was noticed in all the overlying waters measured. Sediment SD-CT-34 had usually the lowest dissolved oxygen concentration.

The pH value, conductivity, alkalinity, hardness and ammonia levels for the initial and final measurements are summarized for each of the sediment in Table A-2 in the Appendix. Also the survivals of midges are included. As mentioned in the previous paragraph, all of these parameter values varied and either increased or decreased or stayed the same. Probably the most variability between start up and final concentrations was recorded for ammonia. This compound decreased in all the overlying water samples for the respective sediments over time, with the exception of SD-CT-13 where the concentration increased by a factor of three from 0.14 to 0.42 mg/L as NH_3-N. The remaining waters analyzed from the various sediments showed significant reductions in the ammonia with time. Over a four fold decrease (426%) was recorded over time in SD-CT-06 (2.30 mg/L to 0.54 mg/L) and SD-CT-34 had decreased 386% (5.8 mg/L to 1.5 mg/L.) The laboratory negative control showed a 257% decrease (0.72 mg/L to 0.28 mg/L) over the 10 days and SD-CT-36 decreased its ammonia concentration by 270%. The ammonia levels in the remaining sediments were reduced by less than 100%. The loss in the ammonia over time is somewhat puzzling, since the majority of the midges had died in the early part of the test. Oligochaetes were still found in most of the sediments and they may have played a part in this venting of ammonia. Another contribution to this loss may have been attributed to the water renewal process, although this was done very carefully to reduce the turbulence and potential mixing. The role of the aquatic flora, namely bacteria, may have been the significant factor in the conversion of ammonia to nitrate and nitrite and hence was not accounted for in the analysis.

APPENDIX A

Supportive Physical, Chemical and Biological Data

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 0

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/7/2006	1245	22.4	390	7.1	5.9
SD-CT-01			22.5	390	7.1	5.8
SD-CT-05			22.6	380	7.1	5.9
SD-CT-06			22.6	420	7.3	5.4
SD-CT-08			22.4	400	7.2	4.8
SD-CT-13			22.5	390	7.7	5.4
SD-CT-34			22.4	490	7.1	4.0
SD-CT-36			22.5	430	7.3	4.1
Moderately Hard Water*			22.6	360	7.9	8.4
			22.1	370	7.9	8.4

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 1

Sediment ID	*Date*	*Time*	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/8/2006	0910	22.5	390	7.7	5.5
		1920	23.0	380	7.6	5.3
SD-CT-01			22.5	380	7.1	5.2
			22.5	380	7.1	4.9
SD-CT-05			22.6	370	7.1	4.9
			22.6	370	7.2	5.0
SD-CT-06			22.6	410	7.3	4.1
			22.9	400	7.3	3.9
SD-CT-08			22.4	390	7.2	4.4
			22.8	370	7.3	4.2
SD-CT-13			22.6	390	7.8	5.7
			22.9	380	7.9	5.4
SD-CT-34			22.6	490	7.1	3.9
			22.8	470	7.2	4.1
SD-CT-36			22.5	420	7.3	3.9
			22.7	400	7.2	4.0
Moderately Hard Water			22.1	360	7.9	8.4
			22.7	360	8.0	8.3

* Moderately Hard Water - Water employed in replacing the overlying water.

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 2

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/9/2006	1030	22.7	420	7.3	4.4
		1930	22.8	400	7.2	4.6
SD-CT-01			22.7	390	7.0	3.9
			22.8	370	7.1	4.4
SD-CT-05			22.7	380	7.0	4.7
			22.9	370	7.1	4.6
SD-CT-06			22.7	420	7.1	4.7
			23.0	380	7.3	4.5
SD-CT-08			22.6	410	7.1	4.4
			23.0	390	7.2	4.6
SD-CT-13			22.6	420	7.4	4.7
			23.1	380	7.7	4.2
SD-CT-34			22.6	520	7.1	4.3
			23.1	470	7.2	3.9
SD-CT-36			22.7	450	7.2	4.0
			23.1	400	7.1	3.9
Moderately Hard Water*			22.7	360	7.0	8.4
			23.2	360	7.9	8.5

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 3

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/10/2006	1000	22.4	420	7.0	3.9
		2000	23.0	400	7.0	4.0
SD-CT-01			22.5	370	7.1	4.6
			22.9	370	7.1	4.8
SD-CT-05			22.5	370	7.1	3.9
			22.9	370	7.1	3.8
SD-CT-06			22.5	390	7.3	4.8
			22.8	380	7.3	4.7
SD-CT-08			22.5	390	7.2	4.0
			22.8	380	7.2	4.1
SD-CT-13			22.5	390	7.7	4.3
			22.8	380	7.6	4.3
SD-CT-34			22.4	410	7.2	3.9
			22.9	400	7.2	3.8
SD-CT-36			22.5	400	7.2	3.8
			22.9	390	7.2	3.7
Moderately Hard Water			22.7	370	7.9	8.3
			23.1	370	8.0	8.3

* Moderately Hard Water - Water employed in replacing the overlying water.

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 4

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/11/2006	0930	22.6	410	6.9	4.1
		2100	23.1	400	7.0	3.9
SD-CT-01			22.6	380	7.2	4.2
			23.0	380	7.2	4.0
SD-CT-05			22.6	370	7.2	4.0
			23.2	360	7.2	4.1
SD-CT-06			22.6	380	7.4	4.3
			23.0	390	7.3	3.9
SD-CT-08			22.7	380	7.3	3.8
			23.1	390	7.3	4.0
SD-CT-13			22.7	380	7.7	4.2
			23.2	390	7.6	4.0
SD-CT-34			22.7	390	7.3	4.1
			23.4	380	7.2	4.3
SD-CT-36			22.8	400	7.3	3.8
			23.0	410	7.3	3.9
Moderately Hard Water*			22.6	370	8.3	7.9
			22.8	380	8.2	7.9

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 5

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/12/2006	0945	22.6	420	6.9	4.1
		1925	23.1	390	6.9	4.2
SD-CT-01			22.4	380	7.1	4.0
			23.0	370	7.0	3.9
SD-CT-05			22.4	370	7.1	4.4
			23.1	370	7.0	4.2
SD-CT-06			22.5	390	7.3	4.1
			23.2	380	7.2	4.0
SD-CT-08			22.6	390	7.3	4.3
			23.2	370	7.2	4.0
SD-CT-13			22.6	390	7.5	3.9
			23.2	390	7.4	3.9
SD-CT-34			22.7	390	7.3	4.0
			23.3	380	7.2	3.8
SD-CT-36			22.7	400	7.2	3.7
			23.2	400	7.2	3.6
Moderately Hard Water			23.0	370	7.9	8.4
			23.2	370	7.9	8.5

* Moderately Hard Water - Water employed in replacing the overlying water.

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 6

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/13/2006	0935	22.8	380	6.7	3.8
		2100	22.6	390	6.6	3.9
SD-CT-01			22.7	370	7.1	3.7
			22.6	360	7.2	3.8
SD-CT-05			22.7	360	7.1	4.1
			22.8	360	7.1	4.0
SD-CT-06			22.7	380	7.3	4.1
			22.7	370	7.3	3.9
SD-CT-08			22.7	370	7.2	4.5
			22.8	370	7.3	4.0
SD-CT-13			22.8	380	7.6	4.1
			22.9	380	7.6	3.9
SD-CT-34			22.8	370	7.3	3.8
			22.9	370	7.3	3.9
SD-CT-36			22.8	380	7.3	3.7
			22.9	380	7.3	3.7
Moderately Hard Water*			22.2	370	7.9	8.2
			23.0	370	7.9	8.4

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 7

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/14/2006	0955	22.5	400	6.7	4.4
		2015	22.6	380	6.6	4.1
SD-CT-01			23.1	370	7.2	4.7
			23.2	360	7.2	3.8
SD-CT-05			23.0	360	7.2	4.3
			23.1	370	7.2	4.2
SD-CT-06			23.0	370	7.2	5.4
			23.4	370	7.3	3.9
SD-CT-08			23.2	370	7.3	5.2
			22.9	370	7.3	4.0
SD-CT-13			23.1	380	7.6	4.4
			22.8	390	7.7	3.8
SD-CT-34			23.2	360	7.3	3.9
			22.9	360	7.3	4.0
SD-CT-36			23.3	380	7.2	3.8
			22.8	380	7.3	3.7
Moderately Hard Water			22.3	380	7.9	8.3
			22.4	380	8.0	8.4

* Moderately Hard Water - Water employed in replacing the overlying water.

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 8

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/15/2006	1045	22.4	370	6.8	4.4
		2015	23.1	360	6.7	4.1
SD-CT-01			22.4	360	7.2	4.7
			23.0	360	7.2	4.8
SD-CT-05			22.4	350	7.3	3.8
			23.1	350	7.2	4.3
SD-CT-06			22.5	360	7.4	5.4
			23.1	360	7.3	3.9
SD-CT-08			22.5	360	7.3	5.2
			23.1	360	7.3	4.0
SD-CT-13			22.6	380	7.6	4.4
			23.1	380	7.6	3.7
SD-CT-34			22.6	360	7.3	3.9
			23.2	360	7.3	3.9
SD-CT-36			22.5	370	7.3	3.8
			23.1	370	7.3	3.7
Moderately Hard Water*			22.4	380	8.0	8.4
			22.7	380	8.0	8.3

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 9

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/16/2006	1030	22.6	370	6.8	3.7
		2100	23.0	370	6.7	3.8
SD-CT-01			22.5	370	7.2	5.0
			23.0	370	7.2	5.0
SD-CT-05			22.6	360	7.3	5.6
			23.0	360	7.3	5.1
SD-CT-06			22.6	370	7.4	5.3
			23.1	360	7.3	4.8
SD-CT-08			22.7	370	7.4	5.8
			23.1	370	7.4	4.6
SD-CT-13			22.7	390	7.7	5.2
			22.9	400	7.8	4.4
SD-CT-34			22.7	370	7.4	4.9
			22.9	380	7.4	4.9
SD-CT-36			22.8	380	7.4	4.4
			22.9	380	7.4	3.8
Moderately Hard Water			22.6	380	7.9	8.1
			22.9	380	8.0	8.3

* Moderately Hard Water - Water employed in replacing the overlying water.

Table A-1 Daily Measured Physical and Chemical Data From Overlying Water for Designated Sediments for Day 10

Sediment ID	Date	Time	Temperature (°C)	Conductivity (µmhos/cm)	pH (S.U.)	D.O. (mg/L)
Lab Control	7/17/2006	1130	22.9	360	6.7	3.8
SD-CT-01			22.9	360	7.2	3.9
SD-CT-05			22.9	370	7.2	3.9
SD-CT-06			22.9	370	7.2	4.2
SD-CT-08			23.1	360	7.3	3.9
SD-CT-13			23.1	380	7.6	3.7
SD-CT-34			23.2	360	7.3	3.7
SD-CT-36			23.2	380	7.3	3.8
Moderately Hard Water*			---	---	---	---

Moderately Hard Water - Water employed in replacing the overlying water.

Table A-2 Physical, Chemical and Biological Data Comparisons Between Day 0 and Day 10 for Overlying Water from Designated Sediment Samples

Sample ID	Day	pH (S.U.)	Conductivity (µmos/cm)	Alkalinity (mg/L CaCO3)	Hardness (mg/L CaCO3)	Ammonia (mg/L NH3)	Survival Number
Lab Control	0	7.1	390	78	96	0.72	80
	10	6.7	360	70	108	0.28	70
SD-CT-01	0	7.1	390	68	92	1.20	80
FieldControl	10	7.2	380	68	96	0.78	0
SD-CT-05	0	7.1	380	66	96	1.00	80
	10	7.2	370	68	96	0.68	0
SD-CT-06	0	7.3	420	70	100	2.30	80
	10	7.2	370	74	92	0.54	1
SD-CT-08	0	7.2	400	84	112	1.80	80
	10	7.3	360	80	104	0.90	0
SD-CT-13	0	7.7	390	78	108	0.14	80
	10	7.6	380	88	108	0.42	1
SD-CT-34	0	7.1	490	90	112	5.80	80
	10	7.3	360	98	108	1.50	0
SD-CT-36	0	7.3	430	84	108	2.60	80
	10	7.3	380	82	108	0.96	0

Table A-3 A Summary of Midge Survival, Dry Weight (dried at 105C) and Ash Free Dry Weight (dried at 550 C) in Designated Sediments

Sediment ID: Laboratory Control

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	8	98.00	92.50	4.50	0.56
B	8	97.00	89.00	7.50	0.94
C	8	81.00	75.00	3.00	0.38
D	10	97.00	90.00	7.00	0.70
E	10	131.00	120.00	10.00	1.00
F	8	103.00	94.00	8.00	1.00
G	9	94.00	86.00	6.50	0.72
H	9	104.00	96.50	7.50	0.83
			Mean Ash Free Wt./Indiv. (mg)		0.77
				Std. Dev.	0.22
				95% C.I.	0.15

Sediment ID: SD-CT-01 (Site Negative Control)

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Sediment ID: SD-CT-05

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Table A-3 A Summary of Midge Survival, Dry Weight (dried at 105C) and Ash Free Dry Weight (dried at 550 C) in Designated Sediments

Sediment ID: SD-CT-06

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	1	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Sediment ID: SD-CT-08

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Sediment ID: SD-CT-13

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	1	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Table A-3 A Summary of Midge Survival, Dry Weight (dried at 105C) and Ash Free Dry Weight (dried at 550C) in Designated Sediments

Sediment ID: SD-CT-34

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Sediment ID: SD-CT-36

Replicate	Survival Number	Initial Wt. (mg)	Final Dry Wt. (mg)	Ash Free Wt. (mg)	Ash Free Wt./Indiv. (mg)
A	0	-	-	-	-
B	0	-	-	-	-
C	0	-	-	-	-
D	0	-	-	-	-
E	0	-	-	-	-
F	0	-	-	-	-
G	0	-	-	-	-
H	0	-	-	-	-
			Mean Ash Free Wt./Indiv. (mg)		-
				Std. Dev.	-
				95% C.I.	-

Table A-4. A Summary of Exposed Midge Survival in Designated Sediments from 7/7/2006 through 7/17/2006

Sample ID	Number of Organisms	Replicate A	B	C	D	E	F	G	H	Survival Mean	Std Dev	Surv.%	95% C.I.
Reference N/A	Initial												
	Final												
Lab Control	Initial	10	10	10	10	10	10	10	10	10			
	Final	8	8	8	10	10	8	9	9	8.75	0.89	87.5	0.62
SD-CT-01 (Site Control)	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	0	0	0		0	
SD-CT-05	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	0	0	0		0	
SD-CT-06	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	1	0	0	0.01	0.35	0.1	0.24
SD-CT-08	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	0	0	0		0	
SD-CT-13	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	1	0	0.01	0.35	0.1	0.24
SD-CT-34	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	0	0	0		0	
SD-CT-36	Initial	10	10	10	10	10	10	10	10	10			
	Final	0	0	0	0	0	0	0	0	0		0	

APPENDIX B

Summary Reference Acute Toxicity Data

With *Chironomus tentans*

1. INTRODUCTION

This report contains the reference toxicity method and data interpretation for the 96 hour acute test for *Chironomus tentans* when exposed to various concentrations of sodium chloride (NaCl).

2.0 PROCEDURE AND METHODS

One 96 hour acute static renewal survival test was performed with *Chironomus tentans.* Methods as outlined in EPA/600/R-99/064 were followed (Table 1). The *C. tentans* test was carried out from July 7, 2006 to July 11, 2006.

2.1 Laboratory Water Supply

A moderately hard water was utilized in our facility for the *C. tentans* culture. Preparation of the reconstituted laboratory water is outlined in EPA/821-R-02-013. The water is made up in volume of 200 L on which water quality parameters are run to check for consistencies between batches. Moderately hard water was used to make up the various concentrations of sodium chloride solution for exposure of *C. tentans.*

2.2 Test Organisms

Chironomus tentans used in this reference experiment was from the same cohort as those organisms employed in the sediment toxicity tests. The midges were late second- early third-instar larvae.

2.3 Experimental Design

The purpose of this test was to evaluate the "relative sensitivity" of the organisms to our reference toxicant, sodium chloride. *C. tentans* were exposed to five concentrations of NaCl solution and one control. Four replicates, with 10 organisms in each, were set up for each concentration and for the control. The organisms were fed with 1.25 ml of Tetrafin® goldfish food (4.0 g solid/L suspension) on day 0 and after renewal on day 2. Routine water quality parameters were measured prior to the transfer of organisms to their respective exposure vessels and at the end of the test.

3.0 RESULTS AND DISCUSSION

Reference toxicity evaluation with *C. tentans* was initiated on July 7, 2006. The test satisfied the validity requirement of 90% survival in the control.

The routine physical-chemical parameters varied little over the test period and these are recorded on the data sheet.

The resulting 96 hour EC_{50} values and 95% confidence intervals, calculated by using Probit Analysis (Tox Stat, v. 3.5, University of Wyoming and West, Inc.), was 8.20 g NaCl/L (7.88, 8.51 95% C.I.)

4.0 SUMMARY

A reference toxicity test with *C. tentans* was carried out with sodium chloride. The test proved valid since 90% or greater survival was achieved in the control after the four days period. The EC_{50} value is comparable to those values obtained previously.

TABLE 1 RECOMMENDED TEST CONDITIONS REFERENCE-TOXICITY TESTS WITH MORE THAN ONE ORGANISM/CHAMBER

1.	Test Type:	Water-only test
2.	Dilution series:	Control and at least 5 test concentrations (0.5 dilution factor)
3.	Toxicant:	NaCl
4.	Temperature (°C):	23 $\pm$ 1°C
5.	Light quality:	Wide-spectrum fluorescence lights
6.	Illuminance:	About 100 to1,000 lux
7.	Photoperiod:	16 h light, 8 h darkness
8.	Renewal of water:	None
9.	Age of organisms:	Second to third instar (about 10-d-old larvae). All *organisms must be third or second instar with at* least 50% of the organisms at third instar.
10.	Test chamber:	300 mL high form lipless beaker
11.	Volume of water:	200 mL
12.	No. of organisms/chamber:	10
13.	No. replicate chambers per treatment:	4
14.	Feeding regime:	1.25 mL Tetrafin® goldfish food (4 g/L stock) on day 0 and day 2)
15.	Substrate:	None
16.	Aeration:	None, unless dissolved oxygen in overlying water drops below 40% of saturation
17.	Dilution water:	Culture water, well water, surface water, site water or reconstituted water
18.	Test chamber cleaning:	None
19.	Water quality:	Hardness, alkalinity, conductivity, dissolved oxygen and pH at the beginning and end of a test. Temperature daily.
20.	Test duration:	96 h
21.	Endpoints	Survival (LC50)
22.	Test acceptability:	90% control survival

Test Method 100.2 EPA Publication 600/R-99/064 (March, 2000).

The change in calcium carbonate concentrations measured in the alkalinity and hardness procedure were minimal for the testing period.

3.2 Biological Aspect

Prior to the transfer of *Chironomus tentans* midges into the eight sediments, indigenous organisms consisting mostly of aquatic worms (Oligochaeta) and midges (Family Chironomidae) were removed. Eight replicates, each containing 100 g of sediments and 175 mL of dilution water, received 10 midges each. Mortality of these organisms was observed within the first few days of the test. It was rather surprising that such a low number of midges survived. In fact a single *Chironomus* was picked from each of the two sediments, namely SD-CT-06 and SD-CT-13. The physical – chemical parameters measured were not that different from the laboratory negative control from which an 87.5% survival was recorded (Table A-4). The cause for this mortality had to be attributed to metals, namely lead, cadmium and zinc for which no data were provided. Based on these results, namely the lack of midge survival, negated the procedure for statistical analyses between sediments and the control. It was somewhat disappointing that the negative site control sediment (SD-CT-01) did not produce surviving midges. It should be noted however that viable oligochaetes were found even after 10 days in most sediments.

4.0 SUMMARY

The dipteran, *Chironomus tentans*, was utilized in evaluating the potential toxicity of seven aquatic sediments and one control for a 10 day period in July, 2006. The physical-chemical parameters measured twice daily in the respective overlying waters of the various sediments varied somewhat. These values, however, were not considerably different than those observed from the laboratory control. Midge survival in the control after 10 days was 87.5% (70 out of 80); whereas only a single organism was recovered from each of the two sediments. The remaining five sediments produced zero midges. Heavy metals, lead, cadmium and zinc, may have been the main cause for this acute toxicity. Due to the lack of surviving midges in the seven sediments, no statistical analysis was performed.

Table 2 Quality Assurance Acute Toxicity Data with *Chironomus tentans*.
From July 7 to July 11, 2006

0 Hr

Parameter	Units																								
Concentration	g NaCl/L	Control-MHW				6 0				7.0				8 0				9 0				10 0			
Replicates		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Number of Individual		10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Temperature	oC	22				22				22				22				22				22			
Dissolved Oxygen	mg/L	8 4				8 4				8.4				8 4				8.3				8 3			
pH	SU	7 9				7.7				7 7				7 7				7 7				7 7			
Conductivity	umhos/cm	360				10900				12520				13520				14850				16250			
Alkalinity	mg/L CaCO3	66																							
Hardness	mg/L CaCO3	100																							

48 Hr*

Parameter	Units																								
Concentration	g NaCl/L	Control-MHW				6 0				7.0				8.0				9.0				10 0			
Replicates		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Number of Individual		10	10	10	10	10	10	10	10	10	10	10	10	10	9	10	8	7	6	6	8	3	1	2	3
Temperature	oC	22				22				22				22				22				22			
Dissolved Oxygen (Initial)	mg/L	8 6				8 6				8.5				8 5				8.5				8 5			
Dissolved Oxygen (mg/L)	mg/L	4 9				5 1				5.4				5 3				4.9				5 0			
pH, Initial	SU	8.0				7.8				7 8				7.8				7 8				7.8			
pH, Final	SU	7 3				7 1				7.1				7 1				7.1				7 1			
Conductivity, Initial	umhos/cm	360				10860				12690				13610				14730				16380			
Conductivity, Final	umhos/cm	370				10910				12490				13570				14890				16310			
Alkalinity	mg/L CaCO3	66																							
Hardness	mg/L CaCO3	100																							

96 Hr

Parameter	Units																								
Concentration	g NaCl/L	Control-MHW				6 0				7.0				8 0				9 0				10 0			
Replicates		A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Number of Individual		10	10	9	10	10	10	10	10	9	9	10	10	4	5	8	6	1	3	2	2	0	1	0	0
Temperature	oC	23				23				23				23				23				23			
Dissolved Oxygen	mg/L	5 4				5.6				5.5				5 3				5 1				5 2			
pH	SU	7 3				7.1				7.1				7 1				7.1				7 1			
Conductivity	umhos/cm	380				10920				12760				13660				14780				16230			

TABLE 3 STATISTICAL ANALYSIS

PROBIT ANALYSIS - NOT USING SMOOTHED PROPORTIONS

DOSE	NUMBER SUBJECTS	NUMBER OBSERVED	OBSERVED PROPORTION	PREDICTED PROPORTION
0.00	40	39	0.9750	1.0000
6.00	40	40	1.0000	0.9251
7.00	40	38	0.9500	0.7836
8.00	40	23	0.5750	0.5509
9.00	40	8	0.2000	0.2987
10.00	40	1	0.0250	0.1181

Est. Mu = 8.1951 Est. Sigma = 1.5238
sd = 0.1623 sd = 0.1668

Chi-Square lack of fit = 663948.4716 Likelihood lack of fit = 46.6652

Table Chi-square = 13.2767 (alpha = 0.01, df = 4)
Table Chi-square = 9.4877 (alpha = 0.05, df = 4)

PROBIT EC ESTIMATES

POINT	UNADJUSTED EST. END POINT	95% CONFIDENCE LIMITS	
EC 1	4.6502	3.8580	5.4424
EC 5	5.6887	5.0941	6.2832
EC10	6.2423	5.7443	6.7402
EC20	6.9126	6.5152	7.3101
EC25	7.1673	6.8004	7.5342
EC30	7.3960	7.0514	7.7406
EC40	7.8091	7.4892	8.1289
EC50	**8.1951**	**7.8771**	**8.5132**
EC60	8.5812	8.2439	8.9184
EC70	8.9942	8.6169	9.3715
EC75	9.2229	8.8167	9.6291
EC80	9.4776	9.0350	9.9201
EC90	10.1480	9.5951	10.7008
EC95	10.7016	10.0477	11.3554
EC99	11.7400	10.8843	12.5958

ATTACHMENT C

BENTHIC COMMUNITY STUDY

Memorandum

To: Jeff Stofferahn, ENTACT & Associates

From: Tom Girman, Jerry Kelly

CC:

Re: Former American Zinc Plant Benthic Community Monitoring

Natural Resources Consulting, Inc. (NRC) performed an investigation of the aquatic macroinvertebrate communities of waterways in the vicinity of the former American Zinc plant in Fairmont City, Illinois, on June 26-30, 2006. The purpose of the investigation was to provide data concerning the area aquatic macroinvertebrate communities in support of a baseline Ecological Risk Assessment being prepared for the site by ENTACT & Associates LLC (ENTACT). The investigation included collection of aquatic macroinvertebrates for analysis of community health and body burdens of specific heavy metals (arsenic, cadmium, lead, and zinc).

METHODS

NRC performed the investigation according to the *Baseline Ecological Risk Assessment Work Plan* (M.T. Bosco & Associates, 2006) and the *Support Sampling Plan for the Old American Zinc Plant Site* (ENTACT, 2006). Based on field conditions and discussions with ENTACT staff, NRC sampled nine locations in waterways within or near the site. A tenth location, East Ditch No. 2, became desiccated before a full sampling effort could be performed. Consequently, only a cursory qualitative taxonomic list could be developed for this waterway.

Several NRC scientists stationed on the banks or wading into the waterways collected aquatic macroinvertebrates with D-frame nets. All available habitats were sampled according to procedures described in Region IV U.S. Environmental Protection Agency guidance documents (*Ecological Assessment Standard Operating Procedures and Quality Assurance Manual*, 2002). A level of effort of up to three sampling hours was applied to each of the nine locations from which tissue and benthic community samples were collected.

Aquatic macroinvertebrates for community assessment analysis were generally identified to the family level in the field. Selected organisms of each taxon were preserved in ethanol and retained for future reference.

Aquatic macroinvertebrate species observed to comprise the majority of the community biomass were retained for tissue analysis. The individual organisms were rinsed in distilled water and transferred to tared, resealable polyethylene bags. The bags of sampled organisms were weighed in the field to provide a mass of 6 to 10 grams for each sample location. Samples were retained on ice until custody was transferred to ENTACT field personnel for shipping to the analytical laboratory.

RESULTS

Aquatic macroinvertebrate organisms included in the samples for tissue analysis are summarized in the attached Table 1. In general, the species included in the tissue analysis samples are either in direct contact with the substrate (scrapers) or are likely to bioconcentrate contaminants (predators).

Aquatic macroinvertebrates were generally identified to family level. Leeches (Hirudinea) and aquatic worms (Oligochaeta) were identified to class level, and water mites (Trombidiformes) to suborder level. Results of the community analyses are included in Table 2. Thirty taxa were identified for the area waterways.

Macroinvertebrate Biotic Index (MBI) values were calculated for the sample locations, including East Ditch No.2, which is based on a very limited sampling effort. The Illinois Environmental Protection Agency (IEPA) has used the MBI for stream assessments since 1983 (*Water Monitoring Strategy 2002-2006*, August 2002). This procedure, developed by Hilsenhoff (1982, 1988) for Wisconsin streams, is a semi-quantitative assessment of organic, oxygen-depleting pollution of flowing waters. Table 2 also shows the results of applying the MBI tolerance values for aquatic macroinvertebrate families based solely on organism presence. This approach is a qualitative assessment, resulting in Tolerance Biotic Index (TBI) values, used by the Wisconsin Department of Natural Resources (Lillie and Schlesser, 1994). The results of applying both the MBI and the TBI indices suggest that most of the area waterways have significant oxygen-depleting pollution concerns.

It should be noted that there are limitations to the use of the aquatic macroinvertebrate community results. Not all of the aquatic macroinvertebrate families identified in Table 2 are assigned tolerance values. Although some of these organisms form an appreciable part of the aquatic macroinvertebrate community, they are not considered in the assessment process because the species of these families subsist, and sometimes thrive, regardless of the oxygen-depleting status of the habitat. Many of the aquatic bug and beetle species and some of the aquatic fly larvae families are air breathers, so the waters' dissolved oxygen concentrations will have little or no effect on the health of these species. Fourteen of the 30 identified taxa have species that are air breathers, and thus provide limited information for a biological assessment of the aquatic macroinvertebrate communities.

REFERENCES

ENTACT, 2006. *Support Sampling Plan for the Old American Zinc Plant Site, Fairmont City, Illinois, Revision 2*, 71 pp.

Hilsenhoff, W.L., 1982. *Using a Biotic Index to Evaluate Water Quality in Streams*, Wisconsin Department of Natural Resources Technical Bulletin No. 132, 22 pp.

Hilsenhoff, W.L., 1987. An Improved Biotic Index of Organic Stream Pollution, *The Great Lakes Entomologist*, 20(1):31-39.

Hilsenhoff, W.L., 1988. Rapid Field Assessment of Organic Pollution with a Family-level Biotic Index, *Journal of the North American Benthological Society*, 7:65-68.

Hilsenhoff, W.L., 1998. A Modification of the Biotic Index of Organic Stream Pollution to Remedy Problems and Permit Its Use throughout the Year, *The Great Lakes Entomologist*, 31(1):1-12.

Illinois Environmental Protection Agency, 2002. *Water Monitoring Strategy 2002-2006*, Publication IEPA/BOW/02-005.

Lillie, R.A., and R.A. Schlesser, 1994. Extracting Additional Information from Biotic Index Samples, *The Great Lakes Entomologist*, 27(3):129-136.

M.T. Bosco & Associates, 2006. *Baseline Ecological Risk Assessment Work Plan for the Old American Zinc Plant Site, Fairmont City, Illinois*, 18 pp.

U.S. Environmental Protection Agency Region IV, 2002. *Ecological Assessment Standard Operating Procedures and Quality Assurance Manual*, 2002

Additional Analysis of Benthic Communities
Former American Zinc Plant

Pursuant to ENTACT's Request, NRC has assessed the potential applicability of selected benthic metrics to the benthic data collected at the Former American Zinc site.

Metrics Described in Numbers 1 through 7

Benthic sampling at the Former American Zinc Site was qualitative in nature. Benthic taxa lists were developed based on qualitative sampling (with a frequency occurrence estimated for the sampled taxa at the time of collection). The data generated from qualitative sampling are not amenable to analysis using metrics which are quantitative in nature and based upon abundance of benthic organisms observed. Specifically, community analyses based on organism or taxa densities, total/relative abundance, Shannon-Wiener Index, or Simpson's Diversity Index, cannot be computed using the Former American Zinc site data.

Potential Applicable Qualitative Metrics

The benthic macroinvertebrate family-level data collected from the Former American Zinc site is useful to assess the benthic communities of the investigated locations. The taxa lists were developed based on qualitative sampling, with a frequency of occurrence estimated for the sampled taxa at the time of collection. This information is appropriate for developing qualitative assessments of the benthic communities.

NRC developed Macroinvertebrate Biotic Index (MBI) values for the sampled locations associated with the Former American Zinc site using a system similar to that used by the Illinois Environmental Protection Agency (IEPA). IEPA uses an MBI metric as a measure of organic, oxygen-depriving pollution in stream environments. In utilizing an MBI, IEPA applies the Hilsenhoff Biotic Index (HBI, Hilsenhoff, 1982, 1987, 1988), which has been refined for use on the taxonomic family level. The HBI system assigns a tolerance value (of low oxygen and high organic waste levels) to aquatic arthropod species found in flowing waters. A higher HBI value, on a scale of 0 to 10, indicates a higher tolerance of low dissolved oxygen and high organic pollution conditions. Implementing the HBI system initially required counting organisms to a 100-count, a semi-quantitative analysis. The HBI count has since been modified to count a maximum of 10 organisms of each encountered taxon. This approach limits bias due to dominance effects of one or two species in a sample (Hilsenhoff, 1998). Using the maximum 10-count per taxon, NRC developed MBI values for all of the benthic sampling locations associated with the Former American Zinc site. This was the only semi-quantitative metric developed for the benthic community analysis.

The MBI values developed for the Former American Zinc site can be used to compare the sampling locations with each other, but their use is somewhat limited in that the MBI was developed as a measure of benthic community response to oxygen-depleting organic wastes (e.g., high biochemical oxygen demand materials) in flowing waters. The lack of flow and continuity of the local waterways at the former American Zinc Plant project area further limits the application of the MBI to the site situation.

Several qualitative metrics can be applied to the collected benthic community data. One of these metrics is the Tolerance Biotic Index (TBI), a variation of the HBI used by the Wisconsin Department of Natural Resources (WDNR, Lillie and Schlesser, 1994). The TBI is the average tolerance value for the taxa assigned tolerance values in a sample.

Other qualitative metrics that can be applied to the project's benthic community data include **taxa richness** (number of identified taxa in a sample), **Community Similarity Index, Jaccard's Coefficient of Community,** and **Community Loss Index**. NRC applied **taxa richness** to the Former American Zinc benthic data and included the values in Tables 1 and 2. For minimally stressed waterways, these values (5 to 18) would be low. The total number of taxa for all of the benthic communities combined is 30.

The taxa identified in the benthic communities generally reflect stressed conditions, especially limitations due to low dissolved oxygen conditions. Of the 30 taxa identified, greater than half (the three snail families, the nine bug families, the three beetle families, and the mosquito family) represent species that are considered air breathers, and independent of the dissolved oxygen concentrations of the waterways.

Both the **Community Similarity Index** and **Jaccard's Coefficient of Community** could be suitably applied to the Former American Zinc site benthic data. To apply either of these metrics, any two sampling sites are compared with each other for the number of shared taxa. The values of both indices range from 0 (no similarity) to 1 (identical taxa lists). The Community Similarity Index and Jaccard's Coefficient of Community have been calculated for the benthic communities sampled as part of the Former American Zinc project the results are tabulated in Table 3. In general, greater similarity, as calculated by both indices, occurs among those benthic communities where the most taxa (13 to 18) were identified. This suggests that the commonality of the sites is not so much a distinction of which taxa the areas will support, but rather whether the sites will support any benthic macroinvertebrate taxa. Benthic macroinvertebrates found at a sampling site are likely those taxa common to the benthic communities of the area. The low similarity values occur because few taxa were found at these sampling locations.

The **Community Loss Index (CLI)** is a measure of the differences of taxa occurring in the benthic communities in a waterway from a reference condition, typically an upstream location. A CLI value of zero indicates no loss of taxa in the downstream benthic community compared to that of the reference location. The upper end of the CLI range is open-ended (infinity), indicating complete loss of common taxa between the sampled benthic community and the reference community.

For the Former American Zinc site, CLI values can be developed for those benthic communities that can be considered to fall into a geographic continuum of a waterway. Because of the intermittent nature of Rose Creek and West Ditch No. 1, there are two separate flow patterns that can be assessed for the CLI metric: East Ditch to upper Rose Creek and Schoenberger Creek.

For East Ditch No. 1, the CLI values are:

E Ditch 1 at origin → E Ditch 1 at mouth of E Ditch 2 → Rose Cr at mouth of E Ditch 1
CLI = 0.31 CLI = 0.31

For the Schoenberger Creek (S Cr) system

S Cr above Collinsville Rd → S Cr at mouth of Eng. Ditch → S Cr below Eng. Ditch
CLI = 0.28 CLI = 0.54

These values suggest little loss in benthic community diversity through the stream systems. It should be noted that the upstream, or reference, location on East Ditch No. 1 lies on the former American Zinc Plant site, and may be affected by former operations at the site. In addition, culverts connecting E. Ditch 1 and E. Ditch 2 were observed to be heavily clogged with sediment, effectively isolating the two ditches except under high flow conditions. Also, the upstream Schoenberger Creek location may be subject to ecological stresses in that it is situated approximately 1,000 feet downstream of a railroad yard.

REFERENCES

Hilsenhoff, W.L., 1982. *Using a Biotic Index to Evaluate Water Quality in Streams*, Wisconsin Department of Natural Resources Technical Bulletin No. 132, 22 pp.

Hilsenhoff, W.L., 1987. An Improved Biotic Index of Organic Stream Pollution, *The Great Lakes Entomologist*, 20(1):31-39.

Hilsenhoff, W.L., 1988. Rapid Field Assessment of Organic Pollution with a Family-level Biotic Index, *Journal of the North American Benthological Society*, 7:65-68.

Hilsenhoff, W.L., 1998. A Modification of the Biotic Index of Organic Stream Pollution to Remedy Problems and Permit Its Use throughout the Year, *The Great Lakes Entomologist*, 31(1):1-12.

Lillie, R.A., and R.A. Schlesser, 1994. Extracting Additional Information from Biotic Index Samples, *The Great Lakes Entomologist*, 27(3):129-136.

STL Burlington
Colchester, Vermont

Sample Data Summary Package

SDG: 115113

Job: Fairmount City Bioassay

SEVERN TRENT STL

STL Burlington
208 South Park Drive, Suite 1
Colchester, VT 05446

Tel: 802 655 1203 Fax: 802 655 1248
www.stl-inc.com

July 24, 2006

Ms. Patricia Thomson
ENTACT & Associates LLC
1010 Executive Court
Suite 280
Westmont, IL 60559

Re: Laboratory Project No. 26000
Case: BIOASSAY; SDG: 115113

Dear Ms. Thomson:

Enclosed are the analytical results for the samples that were received by STL Burlington on June 30th and July 1st, 2006. Laboratory identification numbers were assigned, and designated as follows:

Lab ID	Client Sample ID	Sample Date	Sample Matrix
	Received: 07/01/06 ETR No: 115113		
674469	BT-SD-037	06/29/06	Tissue
674470	BT-SD-022	06/30/06	Tissue
674471	EQBLK1		Water
	Received: 06/30/06 ETR No: 115114		
674472	BT-SD05	06/27/06	Tissue
674473	BT-SD001	06/27/06	Tissue
674474	BT-SD06	06/28/06	Tissue
674475	BT-SD06-DUP	06/28/06	Tissue
674476	BT-08	06/28/06	Tissue
674477	BT-SD34	06/28/06	Tissue
674478	BT-SD13	06/29/06	Tissue
674479	BT-SD36	06/29/06	Tissue
674480	PT-SD-31	06/28/06	Tissue
674481	PT-SD-31DUP	06/28/06	Tissue
674482	PT-SD-34	06/28/06	Tissue
674483	PT-16	06/28/06	Tissue
674484	PT-39	06/28/06	Tissue
674485	PT-REF	06/29/06	Tissue
674486	EQBLK2		Water

Documentation of the condition of the samples at the time of their receipt and any exception to the laboratory's Sample Acceptance Policy is documented in the Sample Handling section of this submittal.

The samples were homogenized prior to digestion. The samples were digested for metals by SW846 Method 3050 and analyzed for metals by SW846 Method 6010B, using a project defined target analyte list. Mercury was prepared and analyzed by SW846 Method 7471A. There were no site-specific matrix spike and duplicate analyses requested for the field samples. A batch matrix spike and duplicate anlysis was performed on the sample PT-REF for Method 6010B analysis. There were good recoveries found in the matrix spike analysis and there was good correspondence in the interanalysis comparison for the target elements. A serial dilution analysis was performed on the digestate of sample PT-REF and the results of this analysis indicated a matrix interferences specific to zinc. A laboratory control sample was prepared and analyzed in association with the sample set and the target elements recovered well in those analyses. The analysis of the digestion blank associated with the analytical work did yield trace concentrations of cadmium, lead, mercury and zinc. Equipment blanks, labeled EQBLK1 and EQBLK2, were generated at the time of tissue preparation and carried through the analytical process. The analysis of the equipment blanks yielded a trace concentration of cadmium and zinc.

The analytical results associated with the samples presented in this test report were generated under a quality system that adheres to requirements specified in the NELAC standard. Release of the data in this test report and any associated electronic deliverables is authorized by the Laboratory Director's designee as verified by the following signature.

If there are any questions regarding this submittal, please contact me at 802 655-1203.

Sincerely,

Kristine Dusablon

Kristine Dusablon
Project Manager

Enclosure

STL Burlington Data Qualifier Definitions

Organic

U: Compound analyzed but not detected at a concentration above the reporting limit.

J: Estimated value.

N: Indicates presumptive evidence of a compound. This flag is used only for tentatively identified compounds (TICs) where the identification of a compound is based on a mass spectral library search.

P: SW-846: Greater than 40% difference for detected concentrations between two GC columns. Unless otherwise specified the higher of the two values is reported on the Form I.

CLP SOW: Greater than 25% difference for detected concentrations between two GC columns. Unless otherwise specified the lower of the two values is reported on the Form I.

C: Pesticide result whose identification has been confirmed by GC/MS.

B: Analyte is found in the sample and the associated method blank. The flag is used for tentatively identified compounds as well as positively identified compounds.

E: Compounds whose concentrations exceed the upper limit of the calibration range of the instrument for that specific analysis.

D: Concentrations identified from analysis of the sample at a secondary dilution.

A: Tentatively identified compound is a suspected aldol condensation product.

X,Y,Z: Laboratory defined flags that may be used alone or combined, as needed. If used, the description of the flag is defined in the project narrative.

Inorganic/Metals

E: Reported value is estimated due to the presence of interference.

N: Matrix spike sample recovery is not within control limits.

* Duplicate sample analysis is not within control limits.

B: The result reported is less than the reporting limit but greater than the instrument detection limit.

U: Analyte was analyzed for but not detected above the reporting limit.

Method Codes:

P ICP-AES
MS ICP-MS
CV Cold Vapor AA
AS Semi-Automated Spectrophotometric

SEVERN TRENT STL

STL Chicago
2417 Bond Street
University Park, IL 60466
Phone: 708-534-5200
Fax: 708-534-5211

Report To:
Contact: PAT THOMSON
Company: ENTACT
Address: 1010 EXECUTIVE COURT SUITE 280 WESTMONT IL 60559
Phone: 630-986-2900
Fax: 630-986-0653
E-Mail: pthomson@entact.com

Bill To:
Contact: SAME
Company:
Address:
Phone:
Fax:
PO#: Quote:

Shaded Areas For Internal Use Only ___ of ___

Lab Lot#

Package Sealed Yes No	Samples Sealed Yes No
Received on Ice Yes No	Samples Intact Yes No
Temperature °C of Cooler	
Within Hold Time Yes No	Preserv. Indicated Yes No NA
pH Check OK Yes No NA	Res Cl_2 Check OK Yes No NA
Sample Labels and COC Agree Yes No	COC not present

Sampler Name: Jerry Kelly
Signature: Jerry Kelly
Project Name: OA2 RI
Project Number: C1727
Project Location: Fairmont City IL
Date Required: Standard TAT
Hard Copy: __/__/__
Fax: __/__/__
Lab PM: Bonnie

Refrg # / # / Cont. / Volume / Preserv.

Laboratory ID	MS-MSD	Client Sample ID	Sampling Date	Sampling Time	Matrix	Comp/Grab	TOTAL METALS									Additional Analyses / Remarks
		BT-SD-037	6/29/06	1530	O	G	X									
		BT-SD-022	6/30/06	0730	O	G	X									
																TOTAL METALS = RCRA 8 + Zn

Relinquished By	Company	Date	Time	Received By	Company	Date	Time
Jerry Kelly	NRC	6-30-06	1050	[signature]	ENTACT	6/30/06	1050
[signature]	ENTACT	6-30-06	1360	[signature]	STL VT	7-1-06	1100

Matrix Key
WW = Wastewater
W = Water
S = Soil
SL = Sludge
MS = Miscellaneous
OL = Oil
A = Air
SE = Sediment
SO = Solid
DS = Drum Solid
DL = Drum Liquid
L = Leachate
WI = Wipe
O = MacroInvert.

Container Key
1. Plastic
2. VOA Vial
3. Sterile Plastic
4. Amber Glass
5. Widemouth Glass
6. Other

Preservative Key
1. HCl, Cool to 4°
2. H2SO4, Cool to 4°
3. HNO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn, Cool to 4°
6. Cool to 4°
7. None

COMMENTS

Date Received / /
Courier: **Hand Delivered** ☐
Bill of Lading

SEVERN TRENT **STL**

STL Chicago
2417 Bond Street
University Park, IL 60466
Phone: 708-534-5200
Fax: 708-534-5211

Report To:
Contact: PAT Thomson
Company: ENTACT
Address: 1010 Executive Court
Suite 280, Westmont IL 60559
Phone: 630-986-2900
Fax: 630-986 0653
E-Mail: pthomson@entact.com

To:
Contact: SAME
Company:
Address:
Phone:
Fax:
PO#: Quote:

Shaded Areas For Internal Use ___ of ___

Lab Lot#

Package Sealed Yes No	Samples Sealed Yes No
Received on Ice Yes No	Samples Intact Yes No
Temperature °C of Cooler	
Within Hold Time Yes No	Preserv. Indicated Yes No NA
pH Check OK Yes No NA	Res Cl2 Check OK Yes No NA
COC Agrees / COC not present	

Sampler Name: Jerry Kelly
Signature: Jerry Kelly
Project Name: OAZ RI
Project Number: C1727
Project Location: Fairmont City IL
Lab PM: Bonnie
Date Required: Normal TAT
Hard Copy: __/__/__
Fax: __/__/__

Refrg # / # / Cont. / Volume / Preservative

Laboratory ID	MS/MSD	Client Sample ID	Sampling Date	Sampling Time	Matrix	Comp/Grab	TOTAL METALS	Additional Analyses / Remarks
		BT-SD05	6/27/06	1430	O	G	X	
		BT-SD001	6/27/06	1215	O	G	X	
		BT-SD06	6/28/06	0845	O	G	X	
		BT-SD06-DUP	6/28/06	0845	O	G	X	
		BT-SD08	6/28/06	1100	O	G	X	
		BT-SD34	6/28/06	1530	O	G	X	
		BT-SD13	6/29/06	0930	O	G	X	
		BT-SD36	6/29/06	1230	O	G	X	
								TOTAL METALS =
								RCRA 8 + Zn, Al, B

Relinquished By	Company	Date	Time	Received By	Company	Date	Time
Jerry Kelly	NRC	6-29-06	1510	[signature]	ENTACT	6/29/06	1510
[signature]	ENTACT	6-29-06	1540	Melissa Blas	STL VT	6-30-06	0930

Matrix Key
WW = Wastewater
W = Water
S = Soil
SL = Sludge
MS = Miscellaneous
OL = Oil
A = Air
SE = Sediment
SO = Solid
DS = Drum Solid
DL = Drum Liquid
L = Leachate
WI = Wipe
O = Macro Invertebrates

Container Key
1. Plastic
2. VOA Vial
3. Sterile Plastic
4. Amber Glass
5. Widemouth Glass
6. Other

Preservative Key
1. HCl, Cool to 4°
2. H2SO4, Cool to 4°
3. HNO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn, Cool to 4°
6. Cool to 4°
7. None

COMMENTS

Date Received / /
Courier: **Hand Delivered**
Bill of Lading

SEVERN TRENT **STL**

STL Chicago
2417 Bond Street
University Park, IL 60466
Phone: 708-534-5200
Fax: 708-534-5211

Report To:
Contact: Pat Thomson
Company: Entact
Address: 1010 Executive Ct. Ste 280 Westmont IL 60559
Phone: 630-986-2900
Fax: 630-986-~~00~~053
E-Mail: PThomson@entact.com

To:
Contact: Same.
Company:
Address:
Phone:
Fax:
PO#: Quote:

Shaded Areas For Internal Use ___ of ___

Lab Lot#

Package Sealed Yes No	Samples Sealed Yes No
Received on Ice Yes No	Samples Intact Yes No
Temperature °C of Cooler	
Within Hold Time Yes No	Preserv. Indicated Yes No NA
pH Check OK Yes No NA	Res Cl_2 Check OK Yes No NA
Sample Labels and COC Agree Yes No	COC not present

Sampler Name: Jon Gumtow/Matt Schramm
Signature: Jon Gumtow
Project Name: American Zinc OAZ RI
Project Number: C1727
Project Location: Fairmont, IL
Date Required Normal TAT
Hard Copy: ___/___/___
Fax: ___/___/___
Lab PM: Bonnie

Refrg # / # / Cont. / Volume / Preserv

Laboratory ID	MS-MSD	Client Sample ID	Sampling Date	Sampling Time	Matrix	Comp/Grab	TOTAL METALS	Additional Analyses / Remarks
		PT-SD-31	6/28/06	1030	O	C	X	
		PT-SD-31dup	6/28/06	1030	O	C	X	
		PT-SD-34	6/28/06	1110	O	C	X	HOLD
		PT-~~SD~~ AS 16(1) 38	6/28/06	1300	O	C	X	
		PT-~~SD~~ AS ~~16(2)~~-39	6/28/06	1330	O	C	X	HOLD
		PT-Ref	6/29/06	1115	O	C	X	
								TOTAL METALS = RCRA 8 + Zn

RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME
Jon Gumtow	NRC, Inc	6/29/06	1335	Jeffrey Seffer	ENTACT	6/29/06	1335
Jeffrey Seffer	ENTACT	6-29-06	1540	Melissa Bl	STLVT	6-30-06	0930

Matrix Key
WW = Wastewater
W = Water
S = Soil
SL = Sludge
MS = Miscellaneous
OL = Oil
A = Air
SE = Sediment
SO = Solid
DS = Drum Solid
DL = Drum Liquid
L = Leachate
WI = Wipe
O = Vegetation

Container Key
1. Plastic
2. VOA Vial
3. Sterile Plastic
4. Amber Glass
5. Widemouth Glass
6. Other Ziplock bag

Preservative Key
1. HCl, Cool to 4°
2. H2SO4, Cool to 4°
3. HNO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn, Cool to 4°
6. Cool to 4°
7. None

COMMENTS
Samples collected by NRC and custody transfered to Entact

Date Received / /
Courier: **Hand Delivered**
Bill of Lading

SEVERN TRENT STL

Sample Data Summary Package For Metals

USEPA - CLP FORMS

COVER PAGE - INORGANIC ANALYSES DATA PACKAGE

ab ne: STL BURLINGTON   Contract: 26000

ab Code: STLVT   Case No.: BIOASSAY   SAS No.: ______   SDG No.: 115113

OW No.: ______

EPA Sample No.	Lab Sample ID.
BT-08	674476
BT-SD001	674473
BT-SD-022	674470
BT-SD-037	674469
BT-SD05	674472
BT-SD06	674474
BT-SD06-DUP	674475
BT-SD13	674478
BT-SD34	674477
BT-SD36	674479
EQBLK1	674471
EQBLK2	674486
PT-16	674483
PT-REF	674485
PT-REFD	674485DP
PT-REFS	674485MS
PT-SD-31	674480
PT-SD-31DUP	674481

Were ICP interelement corrections applied? Yes/No YES

Were ICP background corrections applied? Yes/No YES

If yes-were raw data generated before application of background corrections? Yes/No NO

Comments: ______

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: ______   Name: ______

Date: ______   Title: ______

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-08

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674476

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.37	U		P
7440-39-3	Barium	3.0	B		P
7440-43-9	Cadmium	2.2			P
7440-47-3	Chromium	0.16	B		P
7439-92-1	Lead	4.9			P
7439-97-6	Mercury	0.013	U		CV
7782-49-2	Selenium	0.69	B		P
7440-22-4	Silver	0.16	U		P
7440-66-6	Zinc	169		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD001

ab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674473

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.41	B		P
7440-39-3	Barium	0.89	B		P
7440-43-9	Cadmium	0.46			P
7440-47-3	Chromium	0.15	B		P
7439-92-1	Lead	2.4			P
7439-97-6	Mercury	0.029			CV
7782-49-2	Selenium	0.74	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	24.6		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD-022

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674470

Level (low/med): LOW Date Received: 07/01/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.37	U		P
7440-39-3	Barium	1.5	B		P
7440-43-9	Cadmium	0.031	U		P
7440-47-3	Chromium	0.37	B		P
7439-92-1	Lead	0.32	B		P
7439-97-6	Mercury	0.014	U		CV
7782-49-2	Selenium	0.82	B		P
7440-22-4	Silver	0.16	U		P
7440-66-6	Zinc	11.8		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD-037

b Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: ______ SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674469

Level (low/med): LOW Date Received: 07/01/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.35	U		P
7440-39-3	Barium	0.82	B		P
7440-43-9	Cadmium	0.050	B		P
7440-47-3	Chromium	0.20	B		P
7439-92-1	Lead	0.15	B		P
7439-97-6	Mercury	0.014	U		CV
7782-49-2	Selenium	0.62	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	13.3		E	P

Color Before: dark brown Clarity Before: ______ Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts: ______

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD05

b Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674472

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.46	B		P
7440-39-3	Barium	0.65	B		P
7440-43-9	Cadmium	0.90			P
7440-47-3	Chromium	0.19	B		P
7439-92-1	Lead	2.1			P
7439-97-6	Mercury	0.015	U		CV
7782-49-2	Selenium	1.1	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	50.0		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD06

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674474

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.36	U		P
7440-39-3	Barium	0.42	U		P
7440-43-9	Cadmium	0.077	B		P
7440-47-3	Chromium	0.10	U		P
7439-92-1	Lead	0.17	B		P
7439-97-6	Mercury	0.013	U		CV
7782-49-2	Selenium	1.0	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	22.1		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD06-DUP

b Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674475

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.35	U		P
7440-39-3	Barium	0.41	U		P
7440-43-9	Cadmium	0.069	B		P
7440-47-3	Chromium	0.098	U		P
7439-92-1	Lead	0.36	B		P
7439-97-6	Mercury	0.015	U		CV
7782-49-2	Selenium	0.87	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	18.3		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD13

ab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674478

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.62	B		P
7440-39-3	Barium	1.0	B		P
7440-43-9	Cadmium	1.3			P
7440-47-3	Chromium	0.21	B		P
7439-92-1	Lead	1.4			P
7439-97-6	Mercury	0.014	U		CV
7782-49-2	Selenium	0.88	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	32.6		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD34

b Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674477

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.37	U		P
7440-39-3	Barium	10.9	B		P
7440-43-9	Cadmium	0.50			P
7440-47-3	Chromium	0.10	U		P
7439-92-1	Lead	0.22	B		P
7439-97-6	Mercury	0.017	U		CV
7782-49-2	Selenium	0.49	B		P
7440-22-4	Silver	0.16	U		P
7440-66-6	Zinc	75.8		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

BT-SD36

ab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674479

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	1.1			P
7440-39-3	Barium	13.3	B		P
7440-43-9	Cadmium	0.096	B		P
7440-47-3	Chromium	0.18	B		P
7439-92-1	Lead	0.50	B		P
7439-97-6	Mercury	0.016	U		CV
7782-49-2	Selenium	0.72	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	13.3		E	P

Color Before: dark brown Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

EQBLK1

ɔ Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674471

Level (low/med): LOW Date Received: 07/01/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.47	U		P
7440-39-3	Barium	0.54	U		P
7440-43-9	Cadmium	0.046	B		P
7440-47-3	Chromium	0.13	U		P
7439-92-1	Lead	0.20	U		P
7439-97-6	Mercury	0.017	U		CV
7782-49-2	Selenium	0.48	U		P
7440-22-4	Silver	0.20	U		P
7440-66-6	Zinc	0.19	U	E	P

Color Before: colorless Clarity Before: clear Texture:

Color After: colorless Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.
EQBLK2

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674486

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.47	U		P
7440-39-3	Barium	0.54	U		P
7440-43-9	Cadmium	0.040	U		P
7440-47-3	Chromium	0.13	U		P
7439-92-1	Lead	0.20	U		P
7439-97-6	Mercury	0.017	U		CV
7782-49-2	Selenium	0.48	U		P
7440-22-4	Silver	0.20	U		P
7440-66-6	Zinc	0.53	B	E	P

Color Before: colorless Clarity Before: clear Texture:

Color After: colorless Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS

-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

PT-16

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674483

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.35	U		P
7440-39-3	Barium	3.9	B		P
7440-43-9	Cadmium	3.2			P
7440-47-3	Chromium	0.57	B		P
7439-92-1	Lead	1.7			P
7439-97-6	Mercury	0.016	U		CV
7782-49-2	Selenium	0.56	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	84.9		E	P

Color Before: green Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

PT-REF

b Name: STL BURLINGTON   Contract: 26000

Lab Code: STLVT   Case No.: BIOASSAY   SAS No.:   SDG No.: 115113

Matrix (soil/water): TISSUE   Lab Sample ID: 674485

Level (low/med): LOW   Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.35	U		P
7440-39-3	Barium	5.9	B		P
7440-43-9	Cadmium	0.93			P
7440-47-3	Chromium	1.3			P
7439-92-1	Lead	0.27	B		P
7439-97-6	Mercury	0.016	U		CV
7782-49-2	Selenium	0.45	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	19.8		E	P

Color Before: green   Clarity Before: Texture: coarse

Color After: pale yellow   Clarity After: clear   Artifacts:

Comments:

USEPA - CLP FORMS
-1-
INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.
PT-SD-31

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674480

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.35	U		P
7440-39-3	Barium	4.2	B		P
7440-43-9	Cadmium	4.0			P
7440-47-3	Chromium	0.42	B		P
7439-92-1	Lead	1.3			P
7439-97-6	Mercury	0.015	U		CV
7782-49-2	Selenium	0.83	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	287		E	P

Color Before: green Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS
-1-

INORGANIC ANALYSES DATA SHEET

EPA SAMPLE NO.

PT-SD-31DUP

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Lab Sample ID: 674481

Level (low/med): LOW Date Received: 06/30/06

% Solids: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

CAS No.	Analyte	Concentration	C	Q	M
7440-38-2	Arsenic	0.36	U		P
7440-39-3	Barium	3.5	B		P
7440-43-9	Cadmium	3.7			P
7440-47-3	Chromium	0.29	B		P
7439-92-1	Lead	0.90			P
7439-97-6	Mercury	0.016	U		CV
7782-49-2	Selenium	0.53	B		P
7440-22-4	Silver	0.15	U		P
7440-66-6	Zinc	276		E	P

Color Before: green Clarity Before: Texture: coarse

Color After: pale yellow Clarity After: clear Artifacts:

Comments:

USEPA - CLP FORMS

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Lead	1000.0	991.70	99.2	400.0	400.30	100.1	404.50	101.1	P

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Lead				400.0	418.80	104.7	424.80	106.2	P

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Arsenic	250.0	263.30	105.3	100.0	103.30	103.3	98.82	98.8	P
Barium	500.0	485.90	97.2	200.0	199.30	99.6	199.00	99.5	P
Cadmium	500.0	480.30	96.1	100.0	97.50	97.5	96.24	96.2	P
Chromium	500.0	503.30	100.7	200.0	200.50	100.2	200.00	100.0	P
Selenium	250.0	257.60	103.0	100.0	101.50	101.5	100.10	100.1	P
Silver	500.0	483.50	96.7	100.0	103.20	103.2	101.70	101.7	P
Zinc	500.0	481.70	96.3	200.0	190.30	95.2	192.10	96.0	P

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Arsenic				100.0	101.20	101.2	102.30	102.3	P
Barium				200.0	202.00	101.0	198.40	99.2	P
Cadmium				100.0	96.33	96.3	95.07	95.1	P
Chromium				200.0	203.70	101.8	201.40	100.7	P
Selenium				100.0	102.90	102.9	107.50	107.5	P
Silver				100.0	102.50	102.5	102.60	102.6	P
Zinc				200.0	195.90	98.0	193.00	96.5	P

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A
INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R (1)	True	Found	%R (1)	Found	%R (1)	
Mercury	3.0	3.04	101.3	5.0	5.04	100.8	5.01	100.2	CV

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Mercury	3.0	2.98	99.3	5.0	5.01	100.2	5.00	100.0	CV

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2A

INITIAL AND CONTINUING CALIBRATION VERIFICATION

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Initial Calibration Source: Inorganic Ventures/Fisher

Continuing Calibration Source: SPEX/Fisher

Concentration Units: ug/L

Analyte	Initial Calibration			Continuing Calibration					M
	True	Found	%R(1)	True	Found	%R(1)	Found	%R(1)	
Mercury				5.0	5.03	100.6			CV

(1) Control Limits: Mercury 80-120; Other Metals 90-110; Cyanide 85-115

USEPA - CLP FORMS

2B-IN

CRDL STANDARD FOR AA AND ICP

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

AA CRDL Standard Source:

ICP CRDL Standard Source: Inorganic Ventures

Concentration Units: ug/L

				CRDL Standard for ICP				
				Initial			Final	
Analyte	True	Found	%R	True	Found	%R	Found	%R
Lead				10.0	11.11	111.1		

Control Limits: no limits have been established by EPA at this time

USEPA - CLP FORMS

2B-IN

CRDL STANDARD FOR AA AND ICP

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

AA CRDL Standard Source:

ICP CRDL Standard Source: Inorganic Ventures

Concentration Units: ug/L

Analyte	True	Found	%R	CRDL Standard for ICP Initial True	Initial Found	Initial %R	Final Found	Final %R
Arsenic				10.0	11.86	118.6		
Barium				200.0	198.20	99.1		
Cadmium				5.0	6.21	124.2		
Chromium				10.0	10.34	103.4		
Selenium				35.0	36.53	104.4		
Silver				10.0	12.01	120.1		
Zinc				20.0	16.38	81.9		

Control Limits: no limits have been established by EPA at this time

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): SOIL

Preparation Blank Concentration Units (ug/L or mg/kg): MG/KG

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Lead	2.4	B	2.0	U	2.0	U	2.0	U	0.338	B	P

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Lead			2.0	U							P

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): SOIL

Preparation Blank Concentration Units (ug/L or mg/kg): MG/KG

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Arsenic	4.7	U	4.7	U	4.7	U	4.7	U	0.470	U	P
Barium	5.4	U	5.4	U	5.4	U	5.4	U	0.540	U	P
Cadmium	0.7	B	0.8	B	0.4	U	0.4	U	0.040	B	P
Chromium	1.3	U	1.3	U	1.3	U	1.3	U	0.130	U	P
Selenium	6.0	B	4.8	U	4.8	U	4.8	U	0.480	U	P
Silver	2.0	U	2.0	U	2.0	U	2.0	U	0.200	U	P
Zinc	-4.3	B	-5.2	B	-3.2	B	-3.8	B	0.266	B	P

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): WATER

Preparation Blank Concentration Units (ug/L or mg/kg): UG/L

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Arsenic			4.7	U							P
Barium			5.4	U							P
Cadmium			0.4	U							P
Chromium			1.3	U							P
Selenium			4.8	U							P
Silver			2.0	U							P
Zinc			-4.8	B							P

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): SOIL

Preparation Blank Concentration Units (ug/L or mg/kg): MG/KG

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Mercury	0.1	U	0.1	U	0.1	U			0.017	U	CV

USEPA - CLP FORMS

3

BLANKS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Preparation Blank Matrix (soil/water): SOIL

Preparation Blank Concentration Units (ug/L or mg/kg): MG/KG

Analyte	Initial Calib. Blank (ug/L)	C	Continuing Calibration Blank (ug/L) 1	C	2	C	3	C	Preparation Blank	C	M
Mercury	0.1	U	0.1	U	0.1	U	0.1	U	0.022	B	CV

4

ICP INTERFERENCE CHECK SAMPLE

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 ICS Source: Inorganic Ventures

Concentration Units: ug/L

Analyte	True Sol.A	True Sol.AB	Initial Found Sol.A	Initial Found Sol.AB	Initial Found %R	Final Found Sol.A	Final Found Sol.AB	Final Found %R
Lead	0	46	-9	43.1	93.7			

4

ICP INTERFERENCE CHECK SAMPLE

Lab Name: STL BURLINGTON   Contract: 26000

Lab Code: STLVT   Case No.: BIOASSAY   SAS No.:   SDG No.: 115113

ICP ID Number: TJA ICAP 6   ICS Source: Inorganic Ventures

Concentration Units: ug/L

Analyte	True		Initial Found			Final Found		
	Sol.A	Sol.AB	Sol.A	Sol.AB	%R	Sol.A	Sol.AB	%R
Arsenic	0	102	3	103.4	101.4			
Barium	0	506	8	513.2	101.4			
Cadmium	0	937	-7	950.9	101.5			
Chromium	0	500	2	512.7	102.5			
Selenium	0	41	-9	41.1	100.2			
Silver	0	205	-1	209.4	102.1			
Zinc	0	937	-14	952.5	101.7			

USEPA - CLP FORMS

5A

SPIKE SAMPLE RECOVERY

SAMPLE NO.

PT-REPS

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Level (low/med): LOW

% Solids for Sample: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

Analyte	Control Limit %R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R	Q	M
Arsenic	80 - 120	3.3454		0.3534	U	3.08	108.6		P
Barium	80 - 120	158.5385		5.8647	B	153.85	99.2		P
Cadmium	80 - 120	4.7054		0.9316		3.85	98.0		P
Chromium	80 - 120	17.2769		1.2789		15.38	104.0		P
Lead	80 - 120	1.7754		0.2704	B	1.54	97.7		P
Selenium	80 - 120	4.3377		0.4457	B	3.85	101.1		P
Silver	80 - 120	3.8562		0.1504	U	3.85	100.2		P
Zinc	80 - 120	57.7923		19.8421		38.46	98.7		P

Comments:

6

DUPLICATES

SAMPLE NO.

PT-REFD

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Matrix (soil/water): TISSUE Level (low/med): LOW

% Solids for Sample: 100.0 % Solids for Duplicate: 100.0

Concentration Units (ug/L or mg/kg dry weight): MG/KG

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	M
Arsenic		0.3534	U	0.3588	U			P
Barium		5.8647	B	5.2992	B	10.1		P
Cadmium	0.4	0.9316		0.8817		5.5		P
Chromium	0.8	1.2789		1.2023		6.2		P
Lead		0.2704	B	0.2344	B	14.3		P
Selenium		0.4457	B	0.4762	B	6.6		P
Silver		0.1504	U	0.1527	U			P
Zinc		19.8421		17.9160		10.2		P

7

LABORATORY CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: ______ SDG No.: 115113

Solid LCS Source: ERA lot249/USEPA 0996/ERA lot0899

Aqueous LCS Source: ______

Analyte	Aqueous (ug/L)			Solid (mg/kg)					
	True	Found	%R	True	Found	C	Limits		%R
Arsenic				24.0	25.0		19.2	28.8	104.2
Barium				200.0	202.4		160.0	240.0	101.2
Cadmium				25.0	25.1		20.0	30.0	100.4
Chromium				20.0	21.3		16.0	24.0	106.5
Lead				22.0	22.5		17.6	26.4	102.3
Selenium				21.0	24.6		16.8	25.2	117.1
Silver				25.0	25.2		20.0	30.0	100.8
Zinc				50.0	51.3		40.0	60.0	102.6

7

LABORATORY CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Solid LCS Source: ERA lot249/USEPA 0996/ERA lot0899

Aqueous LCS Source:

	Aqueous (ug/L)			Solid (mg/kg)					
Analyte	True	Found	%R	True	Found	C	Limits		%R
Mercury				0.1	0.1		0.1	0.1	100.0

USEPA - CLP FORMS

7

LABORATORY CONTROL SAMPLE

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Solid LCS Source: ERA lot249/USEPA 0996/ERA lot0899

Aqueous LCS Source:

	Aqueous (ug/L)			Solid (mg/kg)					
Analyte	True	Found	%R	True	Found	C	Limits		%R
Mercury				0.1	0.1		0.1	0.1	100.0

9

ICP SERIAL DILUTIONS

SAMPLE NO.

PT-REFL

Lab Name: STL BURLINGTON   Contract: 26000

Lab Code: STLVT   Case No.: BIOASSAY   SAS No.:   SDG No.: 115113

Matrix (soil/water): TISSUE   Level (low/med): LOW

Concentration Units: ug/L

Analyte	Initial Sample Result (I)	C	Serial Dilution Result (S)	C	% Difference	Q	M
Arsenic	4.70	U	23.50	U			P
Barium	78.00	B	74.84	B	4.1		P
Cadmium	12.39		11.86	B	4.3		P
Chromium	17.01		13.26	B	22.0		P
Lead	3.60	B	10.00	U	100.0		P
Selenium	5.93	B	25.34	B	327.3		P
Silver	2.00	U	10.00	U			P
Zinc	263.90		297.50		12.7	E	P

10

INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: ______ SDG No.: 115113

ICP ID Number: ______ Date: 07/01/06

Flame AA ID Number: Leeman Hydra AA

Furnace AA ID Number: ______

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Mercury	253.70		0.2	0.1	CV

Comments:

10

INSTRUMENT DETECTION LIMITS (QUARTERLY)

Lab Name: STL BURLINGTON   Contract: 26000

Lab Code: STLVT   Case No.: BIOASSAY   SAS No.: ______   SDG No.: 115113

ICP ID Number: TJA ICAP 6   Date: 07/01/06

Flame AA ID Number: ______

Furnace AA ID Number: ______

Analyte	Wave-length (nm)	Back-ground	CRDL (ug/L)	IDL (ug/L)	M
Arsenic	189.042		10	4.7	P
Barium	493.409		200	5.4	P
Cadmium	226.502		5	0.4	P
Chromium	267.716		10	1.3	P
Lead	220.353		10	2.0	P
Selenium	196.026		35	4.8	P
Silver	328.068		10	2.0	P
Zinc	206.200		20	1.9	P

Comments: ______

USEPA - CLP FORMS

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for: Al	Ca	Fe	Mg	Ag
Aluminum	308.215	0.0000000	0.0000000	0.0002800	0.0002100	0.0000000
Antimony	206.838	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Arsenic	189.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Barium	493.409	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Boron	249.678	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	226.502	0.0000000	0.0000000	0.0000380	0.0000000	0.0000000
Calcium	317.933	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.716	0.0000000	0.0000000	0.0000050	0.0000000	0.0000000
Cobalt	228.616	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Copper	324.754	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Iron	271.441	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Lead	220.353	-0.0001890	0.0000000	0.0000950	0.0000120	0.0000000
Magnesium	279.079	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.610	0.0000000	0.0000000	0.0000000	0.0000220	0.0000000
Molybdenum	202.030	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Nickel	231.604	0.0000000	0.0000000	0.0000530	0.0000000	0.0000000
Phosphorus	178.287	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Potassium	766.491	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.026	0.0000000	0.0000000	-0.0005680	0.0000000	0.0000000
Silver	328.068	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Sodium	330.232	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Strontium	421.552	0.0000000	0.0000080	0.0000000	0.0000000	0.0000000
Thallium	190.864	0.0000000	0.0000000	0.0000120	0.0000000	0.0000000
Tin	189.989	0.0000000	0.0000000	-0.0000030	0.0000000	0.0000000
Titanium	334.941	0.0000000	0.0000000	0.0000000	0.0000281	0.0000000
Vanadium	292.402	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Zinc	206.200	0.0000000	0.0000000	0.0000230	0.0000000	0.0000000

Comments:

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		As	B	Be	Cd	Co
Aluminum	308.215	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Antimony	206.838	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Arsenic	189.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Barium	493.409	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Boron	249.678	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	226.502	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Calcium	317.933	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.716	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cobalt	228.616	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Copper	324.754	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Iron	271.441	0.0000000	0.0000000	0.0000000	0.0000000	0.0150000
Lead	220.353	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Magnesium	279.079	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.610	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Molybdenum	202.030	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Nickel	231.604	0.0000000	0.0000000	0.0000000	0.0000000	-0.0015000
Phosphorus	178.287	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Potassium	766.491	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.026	0.0000000	0.0000000	0.0000000	0.0000000	-0.0002400
Silver	328.068	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Sodium	330.232	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Strontium	421.552	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	190.864	0.0000000	0.0000000	0.0000000	0.0000000	0.0021000
Tin	189.989	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Titanium	334.941	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Vanadium	292.402	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Zinc	206.200	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Comments:

USEPA - CLP FORMS

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON　　Contract: 26000

Lab Code: STLVT　　Case No.: BIOASSAY　　SAS No.: ______　　SDG No.: 115113

ICP ID Number: TJA ICAP 6　　Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for:				
		Cr	Cu	Mn	Mo	Na
Aluminum	308.215	0.0000000	0.0000000	0.0000000	0.0011560	0.0000000
Antimony	206.838	-0.0059900	0.0000000	0.0000000	0.0000000	0.0000000
Arsenic	189.042	-0.0000190	0.0000000	0.0000000	0.0002340	0.0000000
Barium	493.409	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Boron	249.678	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	226.502	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Calcium	317.933	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.716	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cobalt	228.616	0.0000000	0.0000000	0.0000000	0.0009490	0.0000000
Copper	324.754	0.0000000	0.0000000	0.0000000	0.0002600	0.0000000
Iron	271.441	0.0000000	0.0000000	0.0000000	0.0038000	0.0000000
Lead	220.353	0.0000000	0.0000000	0.0000000	0.0019000	0.0000000
Magnesium	279.079	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.610	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Molybdenum	202.030	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Nickel	231.604	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Phosphorus	178.287	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Potassium	766.491	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.026	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Silver	328.068	0.0000000	0.0000000	0.0000000	0.0005280	0.0000000
Sodium	330.232	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Strontium	421.552	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	190.864	0.0002540	0.0000000	0.0014400	0.0035000	0.0000000
Tin	189.989	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Titanium	334.941	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Vanadium	292.402	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Zinc	206.200	0.0000860	0.0000000	0.0000000	0.0000000	0.0000000

Comments: ____________________

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for: Ni	Pb	P	Sb	Se
Aluminum	308.215	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Antimony	206.838	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Arsenic	189.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Barium	493.409	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Boron	249.678	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	226.502	0.0000870	0.0000000	0.0000000	0.0000000	0.0000000
Calcium	317.933	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.716	0.0001100	0.0000000	0.0000000	0.0000000	0.0000000
Cobalt	228.616	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Copper	324.754	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Iron	271.441	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Lead	220.353	0.0005700	0.0000000	0.0000000	0.0000000	0.0000000
Magnesium	279.079	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.610	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Molybdenum	202.030	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Nickel	231.604	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Phosphorus	178.287	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Potassium	766.491	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.026	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Silver	328.068	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Sodium	330.232	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Strontium	421.552	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	190.864	0.0000000	-0.0003200	0.0000000	0.0000000	0.0000000
Tin	189.989	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Titanium	334.941	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Vanadium	292.402	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Zinc	206.200	0.0000000	0.0002200	0.0000000	0.0000000	0.0000000

Comments:

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for: Si	Sn	Sr	Ti	Tl
Aluminum	308.215	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Antimony	206.838	0.0000000	0.0000000	0.0000000	0.0034000	0.0000000
Arsenic	189.042	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Barium	493.409	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Beryllium	313.042	0.0000000	0.0000000	0.0000000	0.0000090	0.0000000
Boron	249.678	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Cadmium	226.502	0.0000000	0.0000000	0.0000000	0.0002000	0.0000000
Calcium	317.933	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Chromium	267.716	0.0000000	0.0000000	0.0000000	0.0001340	0.0000000
Cobalt	228.616	0.0000000	0.0000000	0.0000000	0.0021600	0.0000000
Copper	324.754	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Iron	271.441	0.0000000	0.0000000	0.0000000	0.0013800	0.0000000
Lead	220.353	0.0000000	0.0000000	0.0000000	0.0018000	0.0000000
Magnesium	279.079	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Manganese	257.610	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Molybdenum	202.030	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Nickel	231.604	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Phosphorus	178.287	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Potassium	766.491	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Selenium	196.026	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Silver	328.068	0.0000000	0.0000000	0.0000000	0.0002400	0.0000000
Sodium	330.232	0.0000000	0.0000000	0.0000000	0.1776000	0.0000000
Strontium	421.552	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Thallium	190.864	0.0000000	0.0000000	0.0000000	0.0002500	0.0000000
Tin	189.989	0.0000000	0.0000000	0.0000000	0.0004400	0.0000000
Titanium	334.941	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Vanadium	292.402	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Zinc	206.200	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Comments:

11A
ICP INTERELEMENT CORRECTION FACTORS (ANNUALLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 01/27/06

Analyte	Wave-length (nm)	Interelement Correction Factors for: V	Zn			
Aluminum	308.215	0.0265000	0.0000000			
Antimony	206.838	-0.0002800	0.0000000			
Arsenic	189.042	-0.0002800	0.0000000			
Barium	493.409	0.0000000	0.0000000			
Beryllium	313.042	0.0005800	0.0000000			
Boron	249.678	0.0000000	0.0000000			
Cadmium	226.502	0.0000000	0.0000000			
Calcium	317.933	0.0000000	0.0000000			
Chromium	267.716	-0.0001800	0.0000000			
Cobalt	228.616	0.0000000	0.0000000			
Copper	324.754	0.0000000	0.0000000			
Iron	271.441	0.0285500	0.0000000			
Lead	220.353	-0.0001140	0.0000000			
Magnesium	279.079	0.0000000	0.0000000			
Manganese	257.610	0.0000000	0.0000000			
Molybdenum	202.030	0.0000000	0.0000000			
Nickel	231.604	0.0000000	0.0000000			
Phosphorus	178.287	0.0000000	0.0146000			
Potassium	766.491	0.0000000	0.0000000			
Selenium	196.026	0.0000000	0.0000000			
Silver	328.068	-0.0001200	0.0000000			
Sodium	330.232	-0.1508200	0.0582800			
Strontium	421.552	0.0000000	0.0000000			
Thallium	190.864	0.0016200	0.0000000			
Tin	189.989	0.0000000	0.0000000			
Titanium	334.941	0.0000000	0.0000000			
Vanadium	292.402	0.0000000	0.0000000			
Zinc	206.200	-0.0001200	0.0000000			

Comments:

12

ICP LINEAR RANGES (QUARTERLY)

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

ICP ID Number: TJA ICAP 6 Date: 07/01/06

Analyte	Integ. Time (Sec.)	Concentration (ug/L)	M
Arsenic	10.00	5000.0	P
Barium	10.00	10000.0	P
Cadmium	10.00	5000.0	P
Chromium	10.00	50000.0	P
Lead	10.00	100000.0	P
Selenium	10.00	5000.0	P
Silver	10.00	2000.0	P
Zinc	10.00	10000.0	P

Comments:

USEPA - CLP FORMS

13

PREPARATION LOG

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Method: CV

EPA Sample No.	Preparation Date	Initial Volume mL	Volume (mL)
EQBLK1	07/13/06	0.29	50.0
EQBLK2	07/13/06	0.30	50.0
LCSS071306A	07/13/06	0.50	50.0
PBS071306A	07/13/06	0.30	50.0

USEPA - CLP FORMS

13

PREPARATION LOG

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: ______ SDG No.: 115113

Method: CV

EPA Sample No.	Preparation Date	Initial Volume mL	Volume (mL)
BT-08	07/14/06	0.39	50.0
BT-SD001	07/14/06	0.36	50.0
BT-SD-022	07/14/06	0.36	50.0
BT-SD-037	07/14/06	0.35	50.0
BT-SD05	07/14/06	0.33	50.0
BT-SD06	07/14/06	0.38	50.0
BT-SD06-DUP	07/14/06	0.33	50.0
BT-SD13	07/14/06	0.36	50.0
BT-SD34	07/14/06	0.30	50.0
BT-SD36	07/14/06	0.32	50.0
LCSS071406B	07/14/06	0.50	50.0
PBS071406B	07/14/06	0.30	50.0
PT-16	07/14/06	0.32	50.0
PT-REF	07/14/06	0.32	50.0
PT-SD-31	07/14/06	0.33	50.0
PT-SD-31DUP	07/14/06	0.31	50.0

USEPA - CLP FORMS

13

PREPARATION LOG

Lab Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Method: P

EPA Sample No.	Preparation Date	Initial Volume mL	Volume (mL)
BT-08	07/14/06	1.28	100.0
BT-SD001	07/14/06	1.35	100.0
BT-SD-022	07/14/06	1.28	100.0
BT-SD-037	07/14/06	1.34	100.0
BT-SD05	07/14/06	1.31	100.0
BT-SD06	07/14/06	1.30	100.0
BT-SD06-DUP	07/14/06	1.33	100.0
BT-SD13	07/14/06	1.31	100.0
BT-SD34	07/14/06	1.28	100.0
BT-SD36	07/14/06	1.31	100.0
EQBLK1	07/14/06	1.00	100.0
EQBLK2	07/14/06	1.00	100.0
LCSS071406C	07/14/06	1.00	100.0
PBS071406C	07/14/06	1.00	100.0
PT-16	07/14/06	1.33	100.0
PT-REF	07/14/06	1.33	100.0
PT-REFD	07/14/06	1.31	100.0
PT-REFS	07/14/06	1.30	100.0
PT-SD-31	07/14/06	1.34	100.0
PT-SD-31DUP	07/14/06	1.32	100.0

USEPA - CLP FORMS

14

ANALYSIS RUN LOG

Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Instrument ID Number: TJA ICAP 6 Method: P

Start Date: 07/17/06 End Date: 07/17/06

EPA Sample No.	D/F	Time	% R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1258													X												
S	1.00	1303																									
S	1.00	1308													X												
S	1.00	1313																									
ICV	1.00	1319													X												
ICB	1.00	1325													X												
ICSA	1.00	1331													X												
ICSAB	1.00	1336													X												
CRI	1.00	1342													X												
CCV	1.00	1348													X												
CCB	1.00	1353													X												
ZZZZZZ	1.00	1359																									
ZZZZZZ	1.00	1404																									
ZZZZZ	1.00	1410																									
ZZZZZZ	1.00	1415																									
ZZZZZZ	1.00	1421																									
PBS071406C	1.00	1426													X												
LCSS071406C	1.00	1432													X												
BT-SD-037	1.00	1437													X												
BT-SD-022	1.00	1443													X												
EQBLK1	1.00	1449													X												
CCV	1.00	1454													X												
CCB	1.00	1500													X												
BT-SD05	1.00	1505													X												
BT-SD001	1.00	1511													X												
BT-SD06	1.00	1516													X												
BT-SD06-DUP	1.00	1522													X												
BT-08	1.00	1527													X												
BT-SD34	1.00	1533													X												
BT-SD13	1.00	1539													X												
BT-SD36	1.00	1544													X												
PT-SD-31	1.00	1550													X												
PT-SD-31DUP	1.00	1555													X												
CCV	1.00	1601													X												
CCB	1.00	1606													X												
PT-16	1.00	1612													X												
PT-REF	1.00	1617													X												
PT-REFL	5.00	1623													X												

USEPA - CLP FORMS

14

ANALYSIS RUN LOG

Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Instrument ID Number: TJA ICAP 6 Method: P

Start Date: 07/17/06 End Date: 07/17/06

EPA Sample No.	D/F	Time	% R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
PT-REFS	1.00	1629													X												
PT-REFD	1.00	1634													X												
EQBLK2	1.00	1640													X												
CCV	1.00	1645													X												
CCB	1.00	1651													X												

USEPA - CLP FORMS

14

ANALYSIS RUN LOG

Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: SDG No.: 115113

Instrument ID Number: TJA ICAP 6 Method: P

Start Date: 07/17/06 End Date: 07/18/06

EPA Sample No.	D/F	Time	% R	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	2135				X	X		X		X										X	X				X	
S	1.00	2141																									
S	1.00	2146				X															X						
S	1.00	2151					X		X		X											X				X	
ICV	1.00	2157				X	X		X		X										X	X				X	
ICB	1.00	2203				X	X		X		X										X	X				X	
ICSA	1.00	2208				X	X		X		X										X	X				X	
ICSAB	1.00	2214				X	X		X		X										X	X				X	
CRI	1.00	2220				X	X		X		X										X	X				X	
CCV	1.00	2225				X	X		X		X										X	X				X	
CCB	1.00	2231				X	X		X		X										X	X				X	
PBS071406C	1.00	2236				X	X		X		X										X	X				X	
LCSS071406C	1.00	2242				X	X		X		X										X	X				X	
PT-SD-037	1.00	2247				X	X		X		X										X	X				X	
PT-SD-022	1.00	2253				X	X		X		X										X	X				X	
EQBLK1	1.00	2259				X	X		X		X										X	X				X	
BT-SD05	1.00	2304				X	X		X		X										X	X				X	
BT-SD001	1.00	2310				X	X		X		X										X	X				X	
BT-SD06	1.00	2315				X	X		X		X										X	X				X	
BT-SD06-DUP	1.00	2321				X	X		X		X										X	X				X	
BT-08	1.00	2326				X	X		X		X										X	X				X	
CCV	1.00	2332				X	X		X		X										X	X				X	
CCB	1.00	2337				X	X		X		X										X	X				X	
BT-SD34	1.00	2343				X	X		X		X										X	X				X	
BT-SD13	1.00	2348				X	X		X		X										X	X				X	
BT-SD36	1.00	2354				X	X		X		X										X	X				X	
PT-SD-31	1.00	0000				X	X		X		X										X	X				X	
PT-SD-31DUP	1.00	0005				X	X		X		X										X	X				X	
PT-16	1.00	0011				X	X		X		X										X	X				X	
PT-REF	1.00	0016				X	X		X		X										X	X				X	
PT-REFL	5.00	0022				X	X		X		X										X	X				X	
EQBLK2	1.00	0027				X	X		X		X										X	X				X	
PT-REFS	1.00	0033				X	X		X		X										X	X				X	
CCV	1.00	0038				X	X		X		X										X	X				X	
CCB	1.00	0044				X	X		X		X										X	X				X	
PT-REFD	1.00	0050				X	X		X		X										X	X				X	
CCV	1.00	0055				X	X		X		X										X	X				X	
CCB	1.00	0101				X	X		X		X										X	X				X	

USEPA - CLP FORMS

14

ANALYSIS RUN LOG

Name: STL BURLINGTON　　Contract: 26000

Lab Code: STLVT　　Case No.: BIOASSAY　　SAS No.: ______　　SDG No.: 115113

Instrument ID Number: TJA ICAP 6　　Method: P

Start Date: 07/17/06　　End Date: 07/18/06

EPA Sample No.	D/F	Time	% R	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1557																X									
S0.2	1.00	1559																X									
S0.5	1.00	1601																X									
S1	1.00	1603																X									
S5	1.00	1605																X									
S10	1.00	1607																X									
ICV	1.00	1609																X									
ICB	1.00	1611																X									
CCV	1.00	1613																X									
CCB	1.00	1615																X									
PBS071306A	1.00	1617																X									
LCSS071306A	1.00	1620																X									
EQBLK1	1.00	1621																X									
EQBLK2	1.00	1623																X									
ZZZZZZ	1.00	1625																									
ZZZZZZ	1.00	1627																									
ZZZZZZ	1.00	1629																									
ZZZZZZ	1.00	1631																									
ZZZZZZ	1.00	1633																									
CCV	1.00	1635																X									
CCB	1.00	1637																X									

USEPA - CLP FORMS

14

ANALYSIS RUN LOG

Name: STL BURLINGTON Contract: 26000

Lab Code: STLVT Case No.: BIOASSAY SAS No.: ______ SDG No.: 115113

Instrument ID Number: Leeman Hydra AA Method: CV

Start Date: 07/17/06 End Date: 07/17/06

EPA Sample No.	D/F	Time	% R	Analytes																							
				AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TL	V	ZN	CN
S0	1.00	1122																X									
S0.2	1.00	1124																X									
S0.5	1.00	1126																X									
S1	1.00	1129																X									
S5	1.00	1130																X									
S10	1.00	1133																X									
ICV	1.00	1135																X									
ICB	1.00	1137																X									
CCV	1.00	1139																X									
CCB	1.00	1141																X									
PBS071406B	1.00	1143																X									
LCSS071406B	1.00	1145																X									
BT-SD-037	1.00	1147																X									
BT-SD-022	1.00	1149																X									
BT-SD05	1.00	1151																X									
BT-SD001	1.00	1153																X									
BT-SD06	1.00	1155																X									
BT-SD06-DUP	1.00	1157																X									
BT-08	1.00	1159																X									
CCV	1.00	1201																X									
CCB	1.00	1203																X									
BT-SD34	1.00	1205																X									
BT-SD13	1.00	1207																X									
BT-SD36	1.00	1209																X									
PT-SD-31	1.00	1211																X									
PT-SD-31DUP	1.00	1213																X									
PT-16	1.00	1215																X									
PT-REF	1.00	1217																X									
ZZZZZZ	1.00	1219																									
ZZZZZZ	1.00	1221																									
CCV	1.00	1223																X									
CCB	1.00	1225																X									

ATTACHMENT D

VEGETATION COMMUNITY STUDY

NRC
Natural Resources Consulting, Inc.
119 South Main Street | PO Box 128 | Cottage Grove, Wisconsin 53527-0128
Ph. 608.839.1998 | Fax. 608.839.1995
www.nrc-inc.net

Memorandum

To: Jeff Stofferahn, ENTACT & Associates

From: Matt Scharmm, NRC

Jon Gumtow, NRC

CC: Tom Girman, NRC

Re: Wetland Vegetation Community Assessment, Former American Zinc Plant Site, Fairmont City, Illinois

Date: August 2, 2006

Natural Resources Consulting, Inc. (NRC), performed field evaluation of the wetland vegetation communities in the vicinity of the Former American Zinc facility in Fairmont City, Illinois. The evaluation was completed between June 28-30, 2006, and included collection of plant tissue samples for chemical analysis and completion of vegetation surveys and a Floristic Quality Assessment Index (FQAI) for the vegetation communities evaluated.

The purpose of the assessment was to provide quantitative data concerning the condition of hydrologically-connected (downstream) wetland vegetation communities of the Former American Zinc facility. This study was completed in support of a baseline Ecological Risk Assessment being prepared for the site by ENTACT & Associates LLC (ENTACT).

METHODS

NRC performed the field evaluation in accordance with the *Baseline Ecological Risk Assessment Work Plan* (M.T. Bosco & Associates, 2006) and the *Support Sampling Plan for the Old American Zinc Plant Site* (ENTACT, 2006). Sample data was collected in the Old Cahokia Creek wetland complex located north of the Former American Zinc facility. NRC collected vegetation data at two downstream wetland locations (the West Ditch Outfall and Rose Creek Outfall) and one Reference Area or background wetland location (located at the former Golf Course). The West Ditch Outfall, Rose Creek Outfall, and the Reference Area exist within the same wetland complex, however, the Reference Area appears to be hydrologically isolated from surface and groundwater influences of the West Ditch and Rose Creek outfalls, as well as the Former American Zinc site.

Plant Tissue Sampling

Plant tissue samples were collected to evaluate potential chemical uptake at the outfall locations. Two plant tissue samples were collected at the West Ditch Outfall wetland. One sample was located near the stormwater outfall on the south edge of the wetland complex, and a second near the north edge of the area investigated for the vegetation community survey. Two plant tissue samples were collected at the Rose Creek Outfall wetland (one at each vegetation community survey plot location). One plant tissue sample was also collected from the Reference Area wetland location. A duplicate plant tissue sample was collected per requirements of the workplan.

Tissue samples were collected from herbaceous plants showing visual signs of environmental stress such as chlorosis, malformed leaves, and leaf necrosis. Approximately 50 to 60 grams of tissue material were collected at each sample location. Each location included a composite from three to five different plant species.

Tissue samples were collected using scissors, forceps, and clean nitrile gloves. Sample equipment was decontaminated using Alconox and a de-ionized water rinse between locations. The plant materials for each sample were washed with de-ionized water to remove dust or sediment deposits and dried. Samples were place in plastic Ziplock bags and stored in a cooler with ice until transfer of chain of custody to ENTACT on June 29, 2006.

Vegetation Community Sampling

Wetland vegetation communities were surveyed using procedures described in the U.S. *Environmental Protection Agency guidance document Methods for Evaluating Wetland Condition #10 - Using Vegetation to Assess Environmental Conditions in Wetlands* (USEPA 2002) and methods for conducting floristic quality assessments in Illinois (Taft and others 1997; Swink and Wilhelm 1994). The heterogeneous nature of the Old Cahokia Creek wetland complex and unknown disturbance histories of the survey areas precluded establishing sample locations with uniform plant community characteristics. Based on discussions with ENTACT staff, NRC selected sample locations with similar hydrologic regimes and similar topographic positions on the landscape within the wetland complex. Depositional environments downstream of the outfalls were selected to represent variations in disturbance regimes between the West Ditch Outfall, Rose Creek Outfall, and Reference Area. At the West Ditch Outfall and Rose Creek Outfall survey areas, the sampling locations encompassed areas of obvious disturbances and signs of environmental stress (chlorosis, stunted growth, leaf deformation and/or necrosis) to the dominant vegetation of the plant communities. The sampling areas were selected to represent semi-open to open herbaceous or shrub-scrub wetland community types characteristic of disturbed stormwater outfalls.

The vegetation communities were surveyed using a combination of the standard releve *(Braun-Blanquet) and transect sampling methods. A minimum of one 100 m^2 (10m x 10m)* releve plot was established for each survey area. At the West Ditch Outfall, a 70m baseline transect was established across the longitudinal axis of the depositional environment of the outfall, and three releve plots were taken at 5m, 45m, and 60m along the west side of the transect. At the Rose Creek Outfall, the releve plot was located at the termini of the Rose Creek channel about 250m north of Collinsville Road. At the Reference Location Area, the releve plot was located about 50m northwest of an existing Fairmount City storm sewer outfall.

Belt transects were also used at the Rose Creek Outfall and Reference Area to sample conditions within relatively discrete (narrow, smaller than 100 m^2 in size) plant communities associated with stormwater-influenced environments. At the Rose Creek Outfall, a 1m x 10m belt transect was established across a disturbed wet meadow immediately downstream of the Rose Creek channel. Signs of stormwater flow over the bank and sediment/debris deposition were evident at this location. A 1m x 10m transect was established at the reference location along the axis of the stormwater discharge channel; upland grassland present on either side of the channel were not sampled.

Two NRC scientists completed an inventory of the plant species present within each releve plot and assigned appropriate coefficients of conservatism (CC) to each species for purposes of developing the FQAI. Individual CC values were taken from Taft and others (1997), which provide values that more adequately reflect species characteristics outside the Chicago Region. The density and percent cover for each doiminant species was also recorded for each releve. For woody and some larger herbaceous species, these measurements were taken directly from the 100 m^2 plots. However, to develop estimates for smaller or more abundant herbaceous plants (e.g.., *Amarathus retroflexus*), one or more 1m x 1m nested quadrats were sampled in "average" conditions within each releve.

A FQAI for each sample location was developed using the formula:

Native Floristic Quality Index (FQI) = Mean C($\sqrt{N}$)

where Mean C= $\sum$Coefficients of CC/N

CC = coefficients of conservatism for individual species

N=native species richness.

Total mean C and a total FQI score was also developed for each sample location using total species richness (native plus non-native species), where non-native species were assigned CC values of zero. Theses measure often better reflects the actual integrity of a site than simply using native species for the FQAI analysis (Taft and others 2006). The native species richness for each community was also calculated by dividing the number of native species by the total number species within each sample.

RESULTS

Results of the FQAI are summarized in the attached Tables 1a-1c (West Ditch Outfall), Tables 2a-2b (Rose Creek Outfall), and Tables 3a-3b (Reference Area). In general, all of the plant communities surveyed are dominated by disturbance tolerant or ruderal (weedy and adventive) species characteristic of highly altered natural environments.

Total FQI scores for the three releve plots at the West Ditch Outfall location ranged from 4.62 to 6.93, with slightly higher FQI scores closer to the stormwater outfall (possibly as a result of microenvironments created by frequent disturbances). Total mean C values ranged from 1.92 to 3.3. The survey area encompasses a rather broad depositional environment that is relatively species poor and in many areas dominated by only a few herbaceous species such as *Amaranthus retroflexus* and *Leersia virginica* and a sparse cover of *Cephalanthus occidentalis*. Overall, native species richness was lower in this community (66.7 to 76.9 percent) than other survey areas. Stressed vegetation (chlorosis, malformed growth) was evident throughout the community, but appeared contained within a relatively distinct line that may potentially correlate to the depositional environment of the stormwater outfall. Undisturbed hardwood swamp habitat dominated by mature *Salix nigra* and *Fraxinus pennsylvanica* borders the survey area on the east and west, with shrub-carr and shallow marsh habitat to the north.

Total FQI scores for the Rose Creek Outfall location ranged from 9.0 for the releve plot to 9.2 for the belt transect. Total mean C values ranged from 1.8 for the releve plot to 2.05 for the belt transect. Overall native species richness was about 80% for the community. Vegetation at the belt transect survey location was predominantly a disturbed wet meadow, while the plant community within the releve plot appeared to be trending successionally from a wet meadow-sedge meadow to a hardwood swamp. Beaver activity was evident in the area of the releve plot, which could partially account for the disturbed, scrub-shrub vegetation. Both sample locations are highly disturbed by stormwater flow. Although Rose Creek was dry at the time of the survey, a significant amount of trash, coarse woody debris, and sediment deposition was evident at several locations within the stream channel. Virtually no vegetation was present within the channel, which was scoured to a depth of two to three feet below the surrounding landscape. This stream downcutting has likely altered the hydrology of adjacent wetlands such as the wet meadow sampled within the belt transect, allowing species more characteristic of drier grasslands to successfully invade the plant community. Stressed vegetation (chlorosis) was evident within both sampling locations, although more localized and generally restricted to the southwest corner of the releve plot (closest to the mouth of the stream channel).

Total FQI scores and total mean C values at the Reference Area were 5.00 and 1.67, with a native species richness of about 67 percent. In contrast, the Total FQI and native species richness for the plant community were higher for the releve plot in the Reference Area (13.06 and 88 percent, respectively). The mean C value for the Reference Area was also slightly higher than the other two survey locations (2.67). The Reference Area is part of a former golf course that has been restored to a large floodplain wetland complex consisting of emergent and wet meadow habitats. No obvious signs of vegetative stress were observed within the Reference Area.

LIMITATIONS

There are limitations to the use of FQAI analysis in this investigation for assessment of overall plant community aquatic health. First, although the environmental conditions of the three sites are generally similar, there is insufficient data to assess the frequency of hydroperiods or to quantify the magnitude of stormwater impacts within the survey areas. These disturbance factors, as well as upstream and adjacent sources of invasive species, can significantly affect the composition and structure of the plant communities. Therefore, it may be difficult to distinguish whether observed field observations are attributable to physical disturbances or from contaminated sediments. Secondly, it has generally been recognized that FQI, and to a lesser extent, mean C values are both area-sensitive metrics, with smaller sample areas generally yielding lower scores than more intense sampling or larger sample areas (Taft and others 2006). In addition, both species richness and FQI scores in Illinois wetlands have been shown to increase with sampling period, suggesting that repeated monitoring tends to yield higher scores than a single, discrete sampling event (Matthews and others 2005).

REFERENCES

ENTACT, 2006. *Support Sampling Plan for the Old American Zinc Plant Site, Fairmont City, Illinois, Revision 2*, 71 pp.

Matthews, J.W., P.A. Tessene, S.C. Wiesbrook, and B.W. Zercher. 2005. Effect of area and isolation on species richness and indices of floristic quality in Illinois, USA wetlands. Wetlands. 25:3 (607-615)

Swink, F. and G. Wilhelm. 1994. *Plants of the Chicago Region, 4th Edition*. Indianapolis: Indiana Academy of Science.

Taft, J.B., C. Hauser, and K. R. Robertson. 2006. Estimating floristic integrity in tallgrass prairie. Biological Conservation. 131:42-51.

Taft, J.B., G.S. Wilhelm, D.H. Ladd, and L.A. Masters. 1997. Floristic quality assessment for vegetation in Illinois: a method for assessing vegetation integrity. Erigenia. 15:3-95.

U.S. Environmental Protection Agency. 2002. *Methods for Evaluating Wetland Condition #10 - Using Vegetation to Assess Environmental Conditions in Wetlands.* Office of Water. EPA-822-R-02-202.

Vegetation Summary Tables

Table 1a. Inventory of Vascular flora within West Ditch Outfall Wetland Plot 1

Species Name	Common Name	WIC	C Value
Amaranthus retroflexus	redroot pigweed	FACU+	0
Cephalanthis occidentalis	buttonbush	OBL	9
Leersia virginica	white grass	FACW	5

	Total C =	**14**
FQI = Mean C x SqRt N	**N =**	**3**
FQI = Floristic Quality Index	**Mean C =**	**4.7**
N = Number of Native Species	**FQI =**	**8.1**
Total N = Total # of native and non-native species	**Total N =**	**3**
	% Native Species =	**100.0**

Table 1b. Inventory of Vascular Flora within West Ditch Outfall Plot 2

Species Name	Common Name	WIC	C Value
Amaranthus retroflexus	red root pigweed	FACU+	0
Carex lacustris	common lake sedge	OBL	6
Cephalanthis occidentalis	buttonbush	OBL	9
Salix nigra	black willow	OBL	4

	Total C =	**19**
FQI = Mean C x SqRt N	**N =**	**4**
FQI = Floristic Quality Index	**Mean C =**	**4.75**
N = Number of Native Species	**FQI =**	**9.5**
Total N = Total # of native and non-native species	**Total N =**	**4**
	% Native Species =	**100.0**

Table 1c. Inventory of Vascular Flora within West Ditch Outfall Plot 3

Note: Plot 3 located closest to stormwater outfall from West Ditch

Species Name	Common Name	WIC	C Value
Agastache nepetoides	yellow giant hyssop	FACU	5
Amaranthus retroflexus	red root pigweed	FACU+	0
Ambrosia artemisiifolia	common radweed	FACU	0
Aster pilosus	white old field aster	FACU+	1
Bidens frondosa	devil's beggars ticks	FACW	1
Carex blanda	common wood sedge	FAC	3
Carex lacustris	common lake sedge	OBL	6
Cephalanthis occidentalis	buttonbush	OBL	9
Daucus carota	Queen Anne's lace	UPL	*
Erigeron annuus	annual fleabane	FAC-	0
Rubus strigosus	Red raspberry	FACW-	3
Solidago canadensis	common goldenrod	FACU	1
Stellaria media	Common chickweed	FACU	*

	Total C =	**29**	
FQI = Mean C x SqRt N	**N =**	**11**	
FQI = Floristic Quality Index	**Mean C =**	**2.64**	
N = Number of Native Species	**FQI =**	**8.7**	
Total N = Total # of native and non-native species	**Total N =**	**13**	
	% Native Species =	**84.6**	

FQI including adventive /non-native species

Total C =	**0**
N =	**13**
Mean C=	**0.00**
FQI =	**0.00**

Average FQI Score (for all 3 plots): **8.78**

* Indicates introduced plants, which are excluded from floristic assessment

Table 2a. Inventory of vascular flora within Rose Creek Outfall Plot 1

Species Name	Common Name	WIC	C Value
Acer negundo	box elder	FACW-	0
Agastache nepetoides	yellow giant hyssop	FACU	5
Amaranthus retroflexus	redroot pigweed	FACU+	0
Ambrosia trifida	giant ragweed	FAC+	0
Aster lateriflorus	calico aster	FACW-	4
Aster puniceus	bristly aster	OBL	8
Bidens frondosa	devil's beggars ticks	FACW	1
Carex blanda	woodland sedge	FAC	1
Carex muskingumensis	muskingum sedge	OBL	8
Commelina communis	asiatic dayflower	FAC	*
Daucus carota	Queen Anne's lace	UPL	*
Erigeron canadensis	horseweed	FAC-	0
Fraxinus pennsylvanica	green ash	FACW	5
Phragmites australis	Common reed	FACW+	1
Sambucus canadensis	common elderberry	FACW-	1
Solidago canadensis	common goldenrod	FACU	1
Toxicodendron radicans	poison ivy	FAC+	2
Tradenscantia ohiensis	Common spiderwort	FACU+	2
Ulmus pumila	Siberian elm	UPL	*
Verbena urticifolia	Hairy white vervain	UPL	5

FQI = Mean C x SqRt N	**Total C =**	**44**
FQI = Floristic Quality Index	**N =**	**17**
N = Number of Native Species	**Mean C =**	**2.6**
	FQI =	**10.7**
Total N = Total # of species (native + non-native)	**Total N =**	**20**
	% Native Species =	**85.0**

FQI including adventives and non-natives

Total C =	**0**
N (total) =	**20**
Mean C =	**0**
FQI =	**0.00**

* Indicates introduced plants, which are excluded from floristic assessment

Table 2b. Inventory of vascular flora within Rose Creek Outfall Plot 2
Note: Depositional environment most similar to West Ditch Outfall Plots 1 & 2 and Reference Plot

Species Name	Common Name	WIC	C Value
Acer negundo	box elder	FACW-	0
Amaranthus retroflexus	red root pigweed	FACU+	0
Ambrosia artemisiifolia	common ragweed	FACU	0
Ambrosia trifida	giant ragweed	FAC+	0
Aster lanceolatus	panicled aster	OBL	3
Bidens connata	purple-stemmed beggar-ticks	OBL	5
Bidens frondosa	devil's beggars ticks	FACW	1
Campensis radicans	trumpet creeper vine	FAC	*
Carex lacustris	common lake sedge	OBL	6
Catalpa speciosa	hardy catalpa	FACU	*
Commelina communis	asiatic dayflower	FAC	*
Cephalanthis occidentalis	buttonbush	OBL	9
Fraxinus pennsylvanica	green ash	FACW	5
Laportea canadensis	wood nettle	FACW	3
Lycopus americanus	American bungleweed	OBL	5
Phragmites australis	Common reed	FACW+	1
Phalaris arundinacea	reed canary grass	FACW+	*
Polygonum amphibium	water smartweed	OBL	4
Populus deltoides	eastern cottonwood	FAC+	2
Solidago canadensis	common goldenrod	FACU	1
Spartina pectinata	prairie cord grass	FACW+	4
Toxicodendron radicans	poison ivy	FAC+	2
Typha angustifolia	narrowleaf cattail	OBL	1
Ulmus pumila	Siberian elm	UPL	*
Salix nigra	black willow	OBL	5

Total C =	**57**
N =	**20**
Mean C =	**2.9**
FQI =	**12.7**
Total N =	**25**
% Native Species =	**80.0**

FQI = Mean C x SqRt N
FQI = Floristic Quality Index
N = Number of Native Species
Total N = Total # of species (native + non-native)

FQI including adventives and non-natives

Total C =	**0**
N (total) =	**25**
Mean C =	**0**
FQI =	**0.00**

* Indicates introduced plants, which are excluded from floristic assessment

Table 3a. Inventory of Vascular Flora within Belt Transect Immediately Downstream of Stormwater Outfall Location

Note: Plot location on landscape, hydrology, etc. compares most directly with West Ditch Outfall Plot #3

Species Name	Common Name	WIC	C Value		
Acer saccharinum	silver maple	FACW	0		
Carduus nutans	nodding thistle	UPL	0		
Carex lacustris	common lake sedge	OBL	6		
Glechoma hederacea	creeping charlie	FACU	*	**FQI including adventive /non-native species**	
Leersia virginica	white grass	FACW	5		
Lonicera maackii	bush honeysuckle	UPL	*		
Solidago canadensis	Common goldenrod	FACU	1		
Toxicodendron radicans	poison ivy	FAC+	2		
Vitis riparia	Riverbank grape	FACW-	2		
		Total C =	**16**	**Total C =**	**0**
FQI = Mean C x SqRt N		**N =**	**7**	**N =**	**9**
FQI = Floristic Quality Index		**Mean C =**	**2.3**	**Mean C=**	**0.00**
N = Number of Native Species		**FQI =**	**6.0**	**FQI =**	**0.00**
Total N = Total # of species (native + non-native)		**Total N =**	**9**		
		% Native Species =	**77.8**		

* Indicates introduced plants, which are excluded from floristic assessment

Table 3b. Inventory of Vacscular Flora within Reference Plot
(similar hydrology and topography to West Ditch plots 2 & 3 and Rose Creek plots)

Species Name	Common Name	WIC	C Value
Acer saccharinum	silver maple	FACW	0
Ambrosia trifida	giant ragweed	FAC+	0
Aster lanceolatus	panicled aster	OBL	3
Carex lacustris	common lake sedge	OBL	6
Carex muskingumensis	muskingum sedge	OBL	8
Carex vulpinoidea	Fox sedge	OBL	2
Cephalanthis occidentalis	buttonbush	OBL	9
Cornus drummundii	rough-leaved dogwood	FAC	2
Calystegia sepium	hedge bindweed	FAC	1
Eleocharis sp.	a spikerush		**
Elymus virginicus	Virginia wild rye	FACW-	4
Erechites hieracifolia	Fireweed	FACU	2
Euonymous fortunei	wintercreeper	UPL	*
Fraxinus pennsylvanica	green ash	FACW	5
Hordium jubatum	squirrel-tail grass	FAC+	*
Leersia virginica	white grass	FACW	5
Polygonum pensylvanicum	Pennsylvania smartweed	FACW+	0

Table 3b. Inventory of Vacscular Flora within Reference Plot (cont.)
(similar hydrology and topography to West Ditch plots 2 & 3 and Rose Creek plots)

Species Name	Common Name	WIC	C Value		
Solidago canadensis	Common goldenrod	FACU	1	**FQI including adventive /non-native species**	
Toxicodendron radicans	poison ivy	FAC+	2		
Typha latifolia	common cattail	OBL	1		
Ulmus americana	American elm	FACW-	3		
Vitis riparia	Riverbank grape	FACW-	2		
		C Total =	**71**	**Total C =**	**0**
FQI = Mean C x SqRt N		**N =**	**22**	**N =**	**24**
FQI = Floristic Quality Index		**Mean C =**	**3.23**	**Mean C=**	**0.00**
N = Number of Native Species		**FQI =**	**15.1**	**FQI =**	**0.00**
Total N = Total # of species (native + non-native)		**Total N =**	**25**		
		% Native Species =	**88**		

* Indicates introduced plants, which are excluded from floristic assessment
**No fruits/seeds present to confirm ID; not used for FQI

Table 1a. Inventory of vascular flora within West Ditch Outfall Wetland Plot 1

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m²)
Amaranthus retroflexus	redroot pigweed	FACU+	*	6	751.5 [a]
Cephalanthis occidentalis	buttonbush	OBL	4	2	0.1
Leersia virginica	white grass	FACW	4	3	50.75 [a]

Notes:

[a] - Measured in four 1m*1m quadrats

			FQI including adventive/non-native species	
	Total C =	**8**	**Total C =**	**8**
FQI = Mean C x SqRt N	**N =**	**2**	**Total N =**	**3**
FQI = Floristic Quality Index	**Mean C =**	**4.0**	**Mean C=**	**2.67**
N = Number of Native Species	**Native FQI =**	**5.7**	**FQI =**	**4.62**
Total N = Total # of native and non-native species	**Total N =**	**3**		
	% Native Species =	**66.7**		

Table 1b. Inventory of Vacscular Flora within West Ditch Outfall Plot 2

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m²)
Amaranthus retroflexus	red root pigweed	FACU+	*	3	127 [a]
Carex lacustris	common lake sedge	OBL	6	3	9.5 [a]
Cephalanthis occidentalis	buttonbush	OBL	4	2	0.1
Salix nigra	black willow	OBL	3	1	0.1

Notes:

[a] - Measured in three 1m*1m quadrats

			FQI including adventive/non-native species	
	Total C =	**13**	**Total C =**	**13**
FQI = Mean C x SqRt N	**N =**	**3**	**Total N =**	**4**
FQI = Floristic Quality Index	**Mean C =**	**4.3**	**Mean C=**	**3.3**
N = Number of Native Species	**Native FQI =**	**7.5**	**FQI =**	**6.5**
Total N = Total # of native and non-native species	**Total N =**	**4**		
	% Native Species =	**75.0**		

Table 1c. Inventory of Vacscular Flora within West Ditch Outfall Plot 3

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m^2)
Agastache nepetoides	yellow giant hyssop	FACU	4	1	<0.1
Amaranthus retroflexus	red root pigweed	FACU+	*	3	0.7 [a]
Ambrosia artemisiifolia	common ragweed	FACU	0	3	0.4 [a]
Aster pilosus	white old field aster	FACU+	0	1	<0.1
Bidens frondosa	devil's beggars ticks	FACW	1	3	0.4 [a]
Carex blanda	common wood sedge	FAC	2	3	1.4
Carex lacustris	common lake sedge	OBL	6	3	1.6
Cephalanthis occidentalis	buttonbush	OBL	4	3	0.1
Daucus carota	Queen Anne's lace	UPL	*	1	<0.1
Erigeron annuus	annual fleabane	FAC-	1	1	0.1
Rubus strigosus	Red raspberry	FACW-	6	2	0.2
Solidago canadensis	common goldenrod	FACU	1	1	0.2
Stellaria media	Common chickweed	FACU	*	1	0.2

Notes:

a - Measured in one 1m*1m quadrat

Plot 3 located closest to stormwater outfall from West Ditch

Open canopy and low species diversity allowed direct count of many herbaceous species in 10m*10m plot

			FQI including adventive/non-native species	
	Total C =	**25**	**Total C =**	**25**
FQI = Mean C x SqRt N	**N =**	**10**	**Total N =**	**13**
FQI = Floristic Quality Index	**Mean C =**	**2.50**	**Mean C=**	**1.92**
N = Number of Native Species	**Native FQI =**	**7.9**	**FQI =**	**6.93**
Total N = Total # of native and non-native species	**Total N =**	**13**		
	% Native Species =	**76.9**		

Average FQI Score (for all 3 plots): **7.02**

Table 2a. Inventory of vascular flora within Rose Creek Outfall Plot 1 (belt trannsect)
(scour/depotitional environment; similar to Reference Belt Transect and West Ditch Plot #3)

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m^2)
Acer negundo	box elder	FACW-	1	1	0.1
Agastache nepetoides	yellow giant hyssop	FACU	4	1	0.2
Amaranthus retroflexus	redroot pigweed	FACU+	*	3	34.6
Ambrosia trifida	giant ragweed	FAC+	0	3	4.3
Aster lateriflorus	calico aster	FACW-	2	2	0.8
Aster puniceus	bristly aster	OBL	7	1	0.9
Bidens frondosa	devil's beggars ticks	FACW	1	2	2.2
Carex blanda	woodland sedge	FAC	2	4	28.8
Carex muskingumensis	muskingum sedge	OBL	6	2	4.2
Commelina communis	asiatic dayflower	FAC	*	1	0.1
Conyza canadensis	horseweed	FAC-	0	1	0.4
Daucus carota	Queen Anne's lace	UPL	*	3	11.9
Fraxinus pennsylvanica	green ash	FACW	5	1	0.1
Phragmites australis	Common reed	FACW+	1	2	2.0
Sambucus canadensis	common elderberry	FACW-	2	3	1.8
Solidago canadensis	common goldenrod	FACU	1	3	13.6
Toxicodendron radicans	poison ivy	FAC+	1	1	0.7
Tradenscantia ohiensis	Common spiderwort	FACU+	3	1	0.8
Ulmus pumila	Siberian elm	UPL	*	1	0.3
Verbena urticifolia	Hairy white vervain	UPL	5	1	0.2

Cover Classes:
1 = 0-1%; 2 = 1-5%; 3= 5-25%; 4= >25-50%; 5= 50-75%; 6= >75-95%; 7 = >95-100%

FQI = Mean C x SqRt N
FQI = Floristic Quality Index
N = Number of Native Species
Total N = Total # of species (native + non-native)

Total C =	**41**
N =	**16**
Mean C =	**2.6**
Native FQI =	**10.3**
Total N =	**20**
% Native Species =	**80.0**

FQI including adventives and non-natives

Total C =	**41**
Total N =`	**20**
Mean C =	**2.05**
FQI =	**9.2**

Table 2b. Inventory of vascular flora within Rose Creek Outfall Plot 2
(Depositional environment; most similar to West Ditch Outfall Plots 1&2 and Reference Plot)

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m^2)
Acer negundo	box elder	FACW-	1	2	[b]
Amaranthus retroflexus	red root pigweed	FACU+	*	3	22.0[a]
Ambrosia artemisiifolia	common ragweed	FACU	0	2	[b]
Ambrosia trifida	giant ragweed	FAC+	0	3	6.75[a]
Bidens connata	purple-stemmed beggar-ticks	OBL	2	1	[b]
Bidens frondosa	devil's beggars ticks	FACW	1	2	4.0[a]
Campensis radicans	trumpet creeper vine	FAC	2	3	[b]
Carex blanda	common wood sedge	FAC	2	1	0.25[a]
Carex lacustris	common lake sedge	OBL	6	4	21.0[a]
Catalpa speciosa	hardy catalpa	FACU	0	3	0.1
Commelina communis	asiatic dayflower	FAC	*	1	[b]
Cephalanthis occidentalis	buttonbush	OBL	4	2	<0.1
Fraxinus pennsylvanica	green ash	FACW	5	2	<0.1
Laportea canadensis	wood nettle	FACW	2	3	[b]
Lycopus americanus	American bungleweed	OBL	3	2	[b]
Phragmites australis	Common reed	FACW+	1	2	[b]
Phalaris arundinacea	reed canary grass	FACW+	*	2	[b]
Polygonum amphibium	water smartweed	OBL	3	2	[b]
Populus deltoides	eastern cottonwood	FAC+	2	3	0.1
Salix nigra	black willow	OBL	3	4	0.1
Solidago canadensis	common goldenrod	FACU	1	3	[b]
Spartina pectinata	prairie cord grass	FACW+	4	2	1.5[a]
Symphyotrichum lanceolatus	panicled aster	OBL	3	2	[b]
Toxicodendron radicans	poison ivy	FAC+	1	2	[b]
Typha angustifolia	narrowleaf cattail	OBL	*	2	1.5[a]
Ulmus pumila	Siberian elm	UPL	*	2	[b]

Notes:

a - Measured in four 1m*1m quadrats;
b - Not present in 1m*1m quadrats, no density measurement taken
Cover Classes:
1 = 0-1%; 2 = 1-5%; 3= 5-25%; 4= >25-50%; 5= 50-75%; 6= >75-95%; 7 = >95-100%

FQI = Mean C x SqRt N
FQI = Floristic Quality Index
N = Number of Native Species
Total N = Total # of species (native + non-native)

Total C =	**46**
N =	**21**
Mean C =	**2.2**
Native FQI =	**10.0**
Total N =	**26**
% Native Species =	**80.8**

FQI including adventives and non-natives

Total C =	**46**
Total N = `	**26**
Mean C =	**1.8**
FQI =	**9.0**

Table 3a. Inventory of Vascular Flora within Reference Site Belt Transect Immediately Downstream of Stormwater Outfall Location

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m²)
Acer saccharinum	silver maple	FACW	1	2	0.1
Carduus nutans	nodding thistle	UPL	*	2	2.5
Carex lacustris	common lake sedge	OBL	6	5	32.2
Glechoma hederacea	creeping charlie	FACU	*	1	0.5
Leersia virginica	white grass	FACW	4	2	2.9
Lonicera maackii	bush honeysuckle	UPL	*	3	0.3
Solidago canadensis	Common goldenrod	FACU	1	1	0.9
Toxicodendron radicans	poison ivy	FAC+	1	1	0.6
Vitis riparia	Riverbank grape	FACW-	2	2	0.2

Note: Plot location on landscape, hydrology, etc. compares most directly with West Ditch Outfall Plot #3

Cover Classes:

1 = 0-1%; 2 = 1-5%; 3= 5-25%; 4= >25-50%; 5= 50-75%; 6= >75-95%; 7 = >95-100%

FQI = Mean C x SqRt N
FQI = Floristic Quality Index
N = Number of Native Species
Total N = Total # of species (native + non-native)

Total C =	**15**
N =	**6**
Mean C =	**2.5**
Native FQI =	**6.1**
Total N =	**9**
% Native Species =	**66.7**

FQI including adventive/non-native species

Total C =	**15**
Total N =	**9**
Mean C=	**1.67**
FQI =	**5.00**

Table 3b. Inventory of Vacscular Flora within Reference Plot (similar hydrology and topography to West Ditch plots 2 & 3 and Rose Creek plots)

Species Name	Common Name	WIC	C Value	Percent Cover (class)	Density (plants/m²)
Acer saccharinum	silver maple	FACW	1	2	0.3[b]
Ambrosia trifida	giant ragweed	FAC+	0	2	[c]
Aster lanceolatus	panicled aster	OBL	3	2	[c]
Calystegia sepium	hedge bindweed	FAC	1	2	[c]
Carex lacustris	common lake sedge	OBL	6	3	11.3[b]
Carex muskingumensis	muskingum sedge	OBL	6	2	2.3[b]
Carex vulpinoidea	Fox sedge	OBL	3	2	[c]
Cephalanthis occidentalis	buttonbush	OBL	4	2	[c]
Cornus drummundii	rough-leaved dogwood	FAC	2	2	[c]
Eleocharis sp.	a spikerush		[a]	2	3.0[b]
Elymus virginicus	Virginia wild rye	FACW-	4	2	[c]
Erechites hieracifolia	Fireweed	FACU	2	2	1.7[b]
Euonymous fortunei	wintercreeper	UPL	*	2	[c]
Fraxinus pennsylvanica	green ash	FACW	5	3	[c]
Hordium jubatum	squirrel-tail grass	FAC+	*	2	[c]
Leersia virginica	white grass	FACW	4	3	44.0[b]
Polygonum pensylvanicum	Pennsylvania smartweed	FACW+	1	1	1.0[b]
Sagittaria latifolia	common arrowhead	OBL	4	2	2.7[b]
Salix nigra	black willow	OBL	3	2	[c]
Sium suave	water parsnip	OBL	5	2	[c]
Solidago canadensis	Common goldenrod	FACU	1	3	[c]
Toxicodendron radicans	poison ivy	FAC+	1	2	[c]
Typha latifolia	common cattail	OBL	1	3	2.7[b]
Ulmus americana	American elm	FACW-	5	2	[c]
Vitis riparia	Riverbank grape	FACW-	2	3	[c]

Notes:

[a] - probably E. palustris, but no fruits/seeds present to confirm ID; not used for FQI

[b] - Measured in three 1m*1m quadrats

[c] - Not present in 1m*1m quadrats; no density measurement taken

Cover Classes:

1 = 0-1%; 2 = 1-5%; 3= 5-25%; 4= >25-50%; 5= 50-75%; 6= >75-95%; 7 = >95-100%

FQI = Mean C x SqRt N
FQI = Floristic Quality Index
N = Number of Native Species
Total N = Total # of species (native + non-native)

C Total =	**64**
N =	**22**
Mean C =	**2.91**
Native FQI =	**13.6**
Total N =	**25**
% Native Species =	**88**

FQI including adventive/non-native species

Total C =	
Total N =	**64**
Mean C=	**24**
FQI =	**2.67**
	13.06

ATTACHMENT E

ERED DATABASE

Table E-1
ERED Results for Benthic Organisms: Arsenic

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Stagnicola emarginatus	Snail	Arsenic	3.6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Stagnicola emarginatus	Snail	Arsenic	3.6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Stagnicola emarginatus	Snail	Arsenic	3.6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Stagnicola emarginatus	Snail	Arsenic	3.6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
2003	St-Jean SD, SC Courtenay, RW Parker	Water Qual Res J Can 38(4):647-666	Mytilus edulis	Mussel	Arsenic	3.6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	
2003	St-Jean SD, SC Courtenay, RW Parker	Water Qual Res J Can 38(4):647-666	Mytilus edulis	Mussel	Arsenic	3.6	MG/KG	Growth	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	Length - Growth in test animals increased in direct proportion to proximity to pulpmill effluent plume which was deemed to reflect not the contaminants, but the increased amounts of nutrients.
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Daphnia magna	Water flea	Arsenic	3.8	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Helisoma campanulata	Snail	Arsenic	4	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Daphnia magna	Water flea	Arsenic	4	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Helisoma campanulata	Snail	Arsenic	4.2	MG/KG	Mortality	ED16	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Daphnia magna	Water flea	Arsenic	4.4	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Helisoma campanulata	Snail	Arsenic	5.8	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Pteronarcys dorsata	Giant Black Stonefly	Arsenic	6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Abundant in streams and rivers across northern half of continent south to Montana, Minnesota, and in Appalachians to Georgia	Larvae primarily detritivores, herbivores in mixed substrata, detritus, woody debris	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Pteronarcys dorsata	Giant Black Stonefly	Arsenic	7	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Abundant in streams and rivers across northern half of continent south to Montana, Minnesota, and in Appalachians to Georgia	Larvae primarily detritivores, herbivores in mixed substrata, detritus, woody debris	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Pteronarcys dorsata	Giant Black Stonefly	Arsenic	8.4	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Abundant in streams and rivers across northern half of continent south to Montana, Minnesota, and in Appalachians to Georgia	Larvae primarily detritivores, herbivores in mixed substrata, detritus, woody debris	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Pteronarcys dorsata	Giant Black Stonefly	Arsenic	8.4	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Abundant in streams and rivers across northern half of continent south to Montana, Minnesota, and in Appalachians to Georgia	Larvae primarily detritivores, herbivores in mixed substrata, detritus, woody debris	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Daphnia magna	Water flea	Arsenic	9.8	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
1980	Spehar, R.L., Fiandt, J.T., Anderson, R.L., Defoe, D.L.	Arch Environ Contam Toxicol 09:53-63	Helisoma campanulata	Snail	Arsenic	16	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph

Highlighted cells indicates selected NOED and LOED concentrations.

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1981	Hatakeyama S, M Yasuno	Ecotoxicol Environ Saf 05:341-380	Moina macrocopa	Cladoceran	Cadmium	0.5	MG/KG	Mortality	NOED	Ingestion	Whole Body	Other	Not Specified	Not Specified	Food is Cadmium fed Chlorella sp.
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.59	MG/KG	Growth	ED20	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.59	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.61	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.61	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
1981	Hatakeyama S, M Yasuno	Ecotoxicol Environ Saf 05:341-380	Moina macrocopa	Cladoceran	Cadmium	0.708	MG/KG	Mortality	LOED	Ingestion	Whole Body	Other	Not Specified	Not Specified	
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.84	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	0.84	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	1	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	1	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
1986	Jenkins, K.D. and B.M. Sanders	Environmental Health Perspectives, Vol. 65, pp. 205-210.	Neanthes arenaceodentata	Neanthes	Cadmium	1.12	MG/KG	Growth	NOED	Absorption	Whole Body	Adult	Not Specified	Feeds on living and dead animals	No difference in weight. Residue value taken from graph and is approximate. Radiotracer study.
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	1.29	MG/KG	Growth	LOED	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	17% Significant Reduction In Growth, Mean Dry Weight Of Animals
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	1.29	MG/KG	Mortality	NOED	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	No effect on mortality.
1984	Sundelin, B.	Ecotoxicological Testing for the Marine Environment, Vol. 2, 588 P, 1984	Monoporeia affinis	Amphipod	Cadmium	2	MG/KG	Mortality	NOED	Combined	Whole Body	Immature	Holarctic, coastal marine, mainly brackish lakes and estuaries, marine-glacial relict lakes	Detritivore	Body Burden Est. From Graph
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	2.38	MG/KG	Growth	ED15	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	15% Significant Reduction In Growth, Mean Dry Weight Of Animals
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	2.38	MG/KG	Mortality	LD45	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	45% Increase in mortality.
1995	Postma J, C Davids	Ecotoxicol Environ Saf 30:195-201	Chironomus riparius	Midge	Cadmium	2.6	MG/KG	Mortality	LD100	Water	Whole Body	Larval	Not Specified	Not Specified	Cadmium residue numbers are for male C.riparius, and are averages of all generations. Effects Data is mixed gender.
1983	Sundelin, B.	Mar Biol 74, 203-212 (1983)	Monoporeia affinis	Amphipod	Cadmium	3	MG/KG	Reproduction	NOED	Combined	Whole Body	Adult	Holarctic, coastal marine, mainly brackish lakes and estuaries, marine-glacial relict lakes	Detritivore	Percent Malformed Eggs
1978	Marshall, J.S.	J Fish Res Bd Can 35:461-469.	Daphnia galeata mendotae	Cladoceran	Cadmium	3.5	MG/KG	Mortality	LOED	Absorption	Whole Body	Population	In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	430% Increase in prenatal mortality (aborted eggs and embryos).
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia galeata mendotae	Cladoceran	Cadmium	3.5	MG/KG	Reproduction	LOED				In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	Marshall, 1978, increased brood size
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia galeata mendotae	Cladoceran	Cadmium	3.5	MG/KG	Reproduction	LOED				In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	Marshall, 1978, prenatal mortality
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia galeata mendotae	Cladoceran	Cadmium	3.5	MG/KG	Reproduction	LOED				In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	Marshall, 1978, reduced longevity
1988	Jenkins KD, AZ Mason	Aquat Toxicol 12:229-244	Neanthes arenaceodentata	Neanthes	Cadmium	3.6	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Time pairing to laying of eggs
1988	Jenkins KD, AZ Mason	Aquat Toxicol 12:229-244	Neanthes arenaceodentata	Neanthes	Cadmium	3.6	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	# eggs
1988	Jenkins, K.D. and A.Z. Mason	Aquat Toxicol 12:229-244.	Nereis arenaceodentata	Polychaete	Cadmium	3.8	MG/KG	Reproduction	NOED	Absorption	Whole Body	NA	Cape Cod to Cape Hatteras; burrows in soft substrata	Predator on small invertebrates	No significant difference in number of eggs/pair or length of time from pairing to egg laying.
1989	Brown AF, D. Pascoe	J. Appl. Ecol 26:473-487	Pomphorhynchus laevis	Acanthocephalan paracite	Cadmium	3.832	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
1996	Tessier, C. and J-S. Blais.	Ecotoxicol Environ Saf 33:246-252.	Dreissena polymorpha	Mussel - Zebra	Cadmium	4	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No increase in mortality.
2003	Heugens EHW, T Jager, R Creyghton, MHS Kraak, AJ Hendriks, NM Van Straalen, and W Admiraal	Environ Sci Tech 37:2145-2151	Daphnia magna	Water flea	Cadmium	4	MG/KG	Mortality	NOED	Water	Whole Body	Neonate	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	At 10 degrees C.
1989	Brown AF, D. Pascoe	J. Appl. Ecol 26:473-487	Gammarus pulex	Amphipod	Cadmium	4.34	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Not Specified	Not Specified	Uninfected G. pulex
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	4.36	MG/KG	Growth	ED28	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	28% Significant Reduction In Growth, Mean Dry Weight Of Animals
1985	Carr, R.S., J.W. Williams, F.I. Saksa, R.L. Buhl and J.M. Neff	Environ Tox & Chem 04:181-188	Mysidopsis bahia	Mysid	Cadmium	4.36	MG/KG	Mortality	LD94	Absorption	Whole Body	Juvenile	Brackish sub-tropical waters	Phytoplankton, small zooplankters	94% Increase in mortality.
1989	Brown AF, D. Pascoe	J. Appl. Ecol 26:473-487	Gammarus pulex	Amphipod	Cadmium	4.48	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Not Specified	Not Specified	Infected G. pulex
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	4.53	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
2005	Stanley, JK; BW Brooks; TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	4.53	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconsituted water
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	4.6	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water Exp_Conc are nominal concentrations
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	4.6	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +0.5 uM EDTA Exp_Conc are nominal concentrations
1995	Postma J, C Davids	Ecotoxicol Environ Saf 30:195-201	Chironomus riparius	Midge	Cadmium	4.8	MG/KG	Mortality	LD60	Water	Whole Body	Larval	Not Specified	Not Specified	Cadmium residue numbers are for male C.riparius, and are averages of all generations. Effects Data is mixed gender.
1986	Mirenda RJ	Arch Environ Contam Toxicol 15:401-407	Orconectes virilis	Crayfish	Cadmium	4.82	MG/KG	Mortality	LD25	Water	Whole Body	Adult	Not Specified	Not Specified	Data further partitioned into gill, hepatopancreas, abdominal muscle, carapace, antennal gland - gill had the highest accumulation
1978	Spehar RL, RL Anderson, JT Fiandt	Environ Pollut 15:195-208	Physa sp.	Snail	Cadmium	5	MG/KG	Survival	ED132	Water	Whole Body	Adult	Not Specified	Not Specified	Abnormal behavior preceded death: snail extended from shell but unable to attach foot
1994	Postma, J.F., M.C. Buckert-de Jong, N. Staats, and C. Davids	Arch Environ Contam Toxicol 26:143-148	Chironomus riparius	Midge	Cadmium	5.6	MG/KG	Mortality	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No increase in mortality.
1978	Marshall, J.S.	J Fish Res Bd Can 35:461-469.	Daphnia galeata mendotae	Cladoceran	Cadmium	5.7	MG/KG	Mortality	NOED	Absorption	Whole Body	Population	In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	No significant difference in average number of individuals and average biomass of population.

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2002	Barata C SJ Markich DJ Baird AMVM Soares	Aquat Toxicol 61 143-154	Daphnia magna	Water flea	Cadmium	6	MG/KG	Mortality	LD50	Water	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone G 62
1981	Hatakeyama S, M Yasuno	Ecotoxicol Environ Saf 05.341-380	Moina macrocopa	Cladoceran	Cadmium	6	MG/KG	Reproduction	ED36	Ingestion	Whole Body	Other	Not Specified	Not Specified	Food is Cadmium fed Chlorella sp
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	6	MG/KG	Mortality	LOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water Exp_Conc are nominal concentrations
1983	Sundelin, B	Mar Biol 74, 203-212 (1983)	Monoporeia affinis	Amphipod	Cadmium	6	MG/KG	Reproduction	LOED	Combined	Whole Body	Adult	Holarctic coastal marine, mainly brackish lakes and estuaries marine-glacial relict lakes	Detritivore	Percent Malformed Eggs
1983	Sundelin, B	Mar Biol 74, 203-212 (1983)	Monoporeia affinis	Amphipod	Cadmium	6	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Holarctic, coastal marine mainly brackish lakes and estuaries, marine-glacial relict lakes	Detritivore	
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	6.4	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +20mg Humic Acid Exp_Conc are nominal concentrations
1996	Rule, J H , and R W Alden III	Environ Tox & Chem 15 466 471	Mytilus edulis	Mussel	Cadmium	6.45	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats may extend to depths over 40 ft	Filter plankton, diatoms, bottom vegetation	Estimated Wet Weight
1989	Brown AF, D Pascoe	J Appl Ecol 26 473-487	Gammarus pulex	Amphipod	Cadmium	7.38	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Not Specified	Not Specified	Uninfected G pulex
2006	Guan R, WX Wang	Environ Pollut 141 343-352	Daphnia magna	Water flea	Cadmium	7.38	MG/KG	Growth	ED13	Water	Whole Body	Juvenile	Southwestern to south central Canada, Northwestern to north-central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	F1 neonates, Multi generational study where adults are exposed to same concentration
1994	Postma J F , M C Buckert de Jong, N Staats, and C Davids	Arch Environ Contam Toxicol 26:143-148	Chironomus riparius	Midge	Cadmium	7.6	MG/KG	Mortality	LOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	increased mortality
1994	Postma J F , M C Buckert-de Jong, N Staats, and C Davids	Arch Environ Contam Toxicol 26.143-148	Chironomus riparius	Midge	Cadmium	7.6	MG/KG	Growth	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No significant difference in weight gain measured in males as dry weight
1994	Postma J F M C Buckert-de Jong N Staats, and C Davids	Arch Environ Contam Toxicol 26 143-148	Chironomus riparius	Midge	Cadmium	7.6	MG/KG	Reproduction	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No significant difference in number of eggs per female
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	7.6	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water Not significantly different from the other measured ED50 values
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48.1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	7.8	MG/KG	Mortality	LOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +20mg Humic Acid Exp_Conc are nominal concentrations
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	7.8	MG/KG	Mortality	LOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +0 5 uM EDTA Exp_Conc are nominal concentrations
2002	Barata C SJ Markich DJ Baird AMVM Soares	Aquat Toxicol 61 143-154	Daphnia magna	Water flea	Cadmium	8	MG/KG	Mortality	LD50	Water	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone G-19
1981	Hatakeyama S and M Yasuno	Ecotoxicol Environ Saf 05 341-350	Moina macrocopa	Cladoceran	Cadmium	8	MG/KG	Reproduction	NOED	Ingestion	Whole Body	Larval	Not Specified	Not Specified	No Effect On Brood Size Residue at 6 days
1981	Hatakeyama S M Yasuno	Ecotoxicol Environ Saf 05 341-380	Moina macrocopa	Cladoceran	Cadmium	8.4	MG/KG	Reproduction	ED22	Ingestion	Whole Body	Other	Not Specified	Not Specified	Food is Cadmium fed Chlorella sp
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48.1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	8.4	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	10 % Tap Water + 90% glass-distilled Water Exp_Conc are nominal concnetrations
2003	Heugens EHW T Jager R Creyghton MHS Kraak AJ Hendriks NM Van Straalen, and W Admiraal	Environ Sci Tech 37 2145-2151	Daphnia magna	Water flea	Cadmium	8.4	MG/KG	Mortality	LD100	Water	Whole Body	Neonate	Southwestern to south-central Canada. Northwestern to north-central US ponds. small lakes, clear and weedy waters	Feeds on algae and similar organisms	At 20 degrees C
1978	Marshall, J S	J Fish Res Bd Can 35 461-469	Daphnia galeata mendotae	Cladoceran	Cadmium	8.6	MG/KG	Mortality	LOED	Absorption	Whole Body	Population	In lakes of northern part of continent, especially glaciated regions	Feeds on algae and similar organisms	Significant decrease in average number of individuals and average biomass of population
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia galeata mendotae	Cladoceran	Cadmium	8.6	MG/KG	Growth	NOED				In lakes of northern part of continent especially glaciated regions	Feeds on algae and similar organisms	Marshall, 1978
1983	Ferard JF JM Jouany R Truhaut P Vasseur	Ecotoxicol Environ Saf 07 43-52	Daphnia magna	Water flea	Cadmium	8.8	MG/KG	Mortality	LD73	Ingestion	Whole Body	NA	Southwestern to south central Canada Northwestern to north-central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	Fed Cadmium exposed Chlorella vulgaris
1991	Borgmann U WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	8.8	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +20mg Humic Acid Not significantly different from the other measured EC50 values
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	8.8	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water +0 5 uM EDTA Not significantly different from the other measured EC50 values
1981	Hatakeyama S, M Yasuno	Ecotoxicol Environ Saf 05 341-380	Moina macrocopa	Cladoceran	Cadmium	9.4	MG/KG	Reproduction	ED64	Ingestion	Whole Body	Other	Not Specified	Not Specified	Food is Cadmium fed Chlorella sp
1991	Borgmann U, WP Norwood IM Babirad	Can J Fish Aquat Sci 48.1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	9.4	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment A Exp_Conc are nominal concentrations
2002	Barata C SJ Markich, DJ Baird AMVM Soares	Aquat Toxicol 61.143 154	Daphnia magna	Water flea	Cadmium	9.6	MG/KG	Mortality	LD50	Combined	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone G-62
1995	Postma J C Davids	Ecotoxicol Environ Saf 30 195-201	Chironomus riparius	Midge	Cadmium	9.8	MG/KG	Mortality	LD60	Water	Whole Body	Larval	Not Specified	Not Specified	Cadmium residue numbers are for male C riparius, and are averages of all generations Effects Data is mixed gender
2006	Guan R, WX Wang	Environ Pollut 141 343-352	Daphnia magna	Water flea	Cadmium	9.98	MG/KG	Growth	ED39	Water	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	F6 neonates: Multi generational study, where adults are exposed to same concentration
1978	Spehar RL, RL Anderson, JT Fiandt	Environ Pollut 15.195-208	Physa sp	Snail	Cadmium	10	MG/KG	Survival	ED117	Water	Whole Body	Adult	Not Specified	Not Specified	
1984	Sundelin, B	Ecotoxicological Testing for the Marine Environment, Vol 2, 588 P, 1984	Monoporeia affinis	Amphipod	Cadmium	10	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Holarctic coastal marine, mainly brackish lakes and estuaries marine-glacial relict lakes	Detritivore	Body Burden Est From Graph
1981	Hatakeyama S and M Yasuno	Ecotoxicol Environ Saf 05 341-350	Moina macrocopa	Cladoceran	Cadmium	10	MG/KG	Reproduction	LOED	Ingestion	Whole Body	Larval	Not Specified	Not Specified	Reduced Brood Size, Residue at 6 days
1981	Hatakeyama S and M Yasuno	Ecotoxicol Environ Saf 05 341 350	Moina macrocopa	Cladoceran	Cadmium	10	MG/KG	Mortality	NOED	Ingestion	Whole Body	Larval	Not Specified	Not Specified	No Effect On Survival Residue at 6 days.
2006	Guan R, WX Wang	Environ Pollut 141 343-352	Daphnia magna	Water flea	Cadmium	10.2	MG/KG	Growth	ED28	Water	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	F2 neonates, Multi generational study where adults are exposed to same concentration
1986	Mirenda RJ	Arch Environ Contam Toxicol 15 401-407	Orconectes virilis	Crayfish	Cadmium	10.32	MG/KG	Mortality	LD74	Water	Whole Body	Adult	Not Specified	Not Specified	Data further partitioned into gill, hepatopancreas, abdominal muscle, carapace, antennal gland - gill had the highest accumulation
1983	Sundelin, B	Mar Biol 74, 203-212 (1983)	Monoporeia affinis	Amphipod	Cadmium	11	MG/KG	Mortality	LOED	Combined	Whole Body	Adult	Holarctic, coastal marine mainly brackish lakes and estuaries, marine-glacial relict lakes	Detritivore	
2003	Heugens EHW T Jager R Creyghton MHS Kraak AJ Hendriks, NM Van Straalen, and W Admiraal	Environ Sci Tech 37 2145-2151	Daphnia magna	Water flea	Cadmium	11	MG/KG	Mortality	LD16	Water	Whole Body	Neonate	Southwestern to south-central Canada, Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	At 26 degrees C
1995	Couillard Y PGC Cambell A Tessier J Pellerin-Massicotte, JC Auclair	Can J Fish Aquat Sci 52 690-702	Anodonta grandis	Freshwater mussel	Cadmium	11.5	MG/KG	Growth	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	Plastic enclosures within lake Group transferred to polluted lake

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1983	Ferard JF, JM Jouany, R Truhaut, P Vasseur	Ecotoxicol Environ Saf 07 43-52	Daphnia magna	Water flea	Cadmium	11.6	MG/KG	Mortality	LD80	Ingestion	Whole Body	NA	Southwestern to south-central Canada Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Fed Cadmium exposed Chlorella vulgaris
1989	Brown AF, D Pascoe	J Appl Ecol 26:473-487	Gammarus pulex	Amphipod	Cadmium	11.77	MG/KG	Mortality	LD97	Water	Whole Body	Adult	Not Specified	Not Specified	Uninfected G. pulex
2002	Barata C, SJ Markich, DJ Baird, AMVM Soares	Aquat Toxicol 61 143-154	Daphnia magna	Water flea	Cadmium	11.8	MG/KG	Mortality	LD50	Water	Whole Body	Juvenile	Southwestern to south-central Canada, Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone S-28
1989	Brown AF, D Pascoe	J Appl Ecol 26:473-487	Gammarus pulex	Amphipod	Cadmium	12.09	MG/KG	Mortality	LD90	Water	Whole Body	Adult	Not Specified	Not Specified	Infected G. pulex
2002	Barata C, SJ Markich, DJ Baird, AMVM Soares	Aquat Toxicol 61 143-154	Daphnia magna	Water flea	Cadmium	12.2	MG/KG	Mortality	LD50	Combined	Whole Body	Juvenile	Southwestern to south-central Canada, Northwestern to north central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone G-62
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	12.4	MG/KG	Mortality	NOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment B Exp_Conc are nominal concentrations
2001	Iles, J., R D Evans, G C Balch	Bull Environ Contam Toxicol 66 484-491	Hydropsyche sp.	Net spinning Caddisfly	Cadmium	12.4	MG/KG	Growth	NOED	Water	Whole Body	Larval	Not Specified	Not Specified	Raised Cadmium concentration with additional Disolved Organic Carbon Weight
2006	Guan R, WX Wang	Environ Pollut 141.343-352	Daphnia magna	Water flea	Cadmium	13.28	MG/KG	Growth	ED46	Water	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	F5 neonates, Multi generational study where adults are exposed to same concentration
2002	Barata C, SJ Markich, DJ Baird, AMVM Soares	Aquat Toxicol 61.143-154	Daphnia magna	Water flea	Cadmium	13.6	MG/KG	Mortality	LD50	Combined	Whole Body	Juvenile	Southwestern to south-central Canada Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	clone G 62
1979	Thorp, J H, Giesy, J P, Wineriter, S A	Arch Environ Contam Toxicol 08.449-456	Cambarus latimanus	Crayfish	Cadmium	14.9	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Streams, lakes, swamps, North Carolina to Florida	Feeds on both plant and animal material	No significant increase in mortality. Feed contaminated with 0.17 ug Cd/g
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	15.2	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	10 % Tap Water + 90% glass-distilled Water Not significantly different from the other measured EC50 values
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	15.2	MG/KG	Mortality	LOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	10 % Tap Water + 90% glass-distilled Water Exp_Conc are nominal concentrations.
2001	Iles, J, R D Evans, G C Balch	Bull Environ Contam Toxicol 66.484-491	Hydropsyche sp.	Net-spinning Caddisfly	Cadmium	15.6	MG/KG	Growth	NOED	Water	Whole Body	Larval	Not Specified	Not Specified	Raised Cadmium concentration without additional Disolved Organic Carbon Weight
1986	Jenkins, K D and B M Sanders	Environmental Health Perspectives, Vol 65, pp 205-210,	Neanthes arenaceodentata	Neanthes	Cadmium	16.8	MG/KG	Growth	LOED	Absorption	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Significant decrease in weight. Residue value taken from graph and is approximate Radiotracer study
1986	Mirenda RJ	Arch Environ Contam Toxicol 15 401-407	Orconectes virilis	Crayfish	Cadmium	16.94	MG/KG	Mortality	LD100	Water	Whole Body	Adult	Not Specified	Not Specified	Data further partitioned into gill, hepatopancreas, abdominal muscle carapace, antennal gland - gill had the highest accumulation
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48.1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	17.2	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment A Not significantly different from the other measured EC50 values
2006	Guan R, WX Wang	Environ Pollut 141 343-352	Daphnia magna	Water flea	Cadmium	17.3	MG/KG	Growth	ED37	Water	Whole Body	Juvenile	Southwestern to south central Canada Northwestern to north-central US ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	F4 neonates, Multi generational study, where adults are exposed to same concentration.
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	17.4	MG/KG	Mortality	LOED	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment A Exp_Conc are nominal concentrations
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	18.48	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902 908	Hyalella azteca	Amphipod Freshwater	Cadmium	18.48	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
1988	Mirenda RJ	Arch Environ Contam Toxicol 15 401-407	Orconectes virilis	Crayfish	Cadmium	18.74	MG/KG	Mortality	LD100	Water	Whole Body	Adult	Not Specified	Not Specified	Data further partitioned into gill, hepatopancreas, abdominal muscle carapace antennal gland gill had the highest accumulation
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	19.2	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment B Not significantly different from the other measured EC50 values
1981	Hatakeyama S, M Yasuno	Ecotoxicol Environ Saf 05 341-380	Moina macrocopa	Cladoceran	Cadmium	20	MG/KG	Reproduction	ED16	Ingestion	Whole Body	Other	Not Specified	Not Specified	Food is Cadmium fed Chlorella sp
1981	Hatakeyama, S and M Yasuno	Ecotoxicol Environ Saf 05 341-350	Moina macrocopa	Cladoceran	Cadmium	20	MG/KG	Reproduction	ED100	Ingestion	Whole Body	Larval	Not Specified	Not Specified	No Reproduction After 12 Days Residue at 6 days
1981	Hatakeyama, S and M Yasuno	Ecotoxicol Environ Saf 05 341 350	Moina macrocopa	Cladoceran	Cadmium	20	MG/KG	Growth	LOED	Ingestion	Whole Body	Larval	Not Specified	Not Specified	Reduced length. Residue at 6 days.
1981	Hatakeyama, S and M Yasuno	Ecotoxicol Environ Saf 05 341-350	Moina macrocopa	Cladoceran	Cadmium	20	MG/KG	Mortality	LOED	Ingestion	Whole Body	Larval	Not Specified	Not Specified	Reduced Survival. Residue at 6 days
1990	Heinis F, Timmermans K R and W R Swain	Aquat Toxicol 16 73-86	Glyptotendipes pallens	Midge	Cadmium	20	MG/KG	Growth	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No significant difference in larval weight or population biomass
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	20.7	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	20.7	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	20.94	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	20.94	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	20.94	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
1980	Duddridge JE and M Wainwright	Water Res 14 1605-1611	Gammarus pulex	Amphipod	Cadmium	22	MG/KG	Mortality	LD100	Ingestion			Not Specified	Not Specified	Exposure Conc ranged from 150-170
1993	Meador JP	J Exp Mar Biol Eco	Eohaustorius estuarius	Amphipod	Cadmium	22	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft	Omnivore-plants, detritus	Animals held 121 d; significantly different than last w/shorter holding time
1979	Thorp, J.H., Giesy, J.P., Wineriter, S.A	Arch Environ Contam Toxicol 08 449-456	Cambarus latimanus	Crayfish	Cadmium	22	MG/KG	Mortality	LOED	Combined	Whole Body	Adult	Streams, lakes, swamps, North Carolina to Florida	Feeds on both plant and animal material	Significant increase in mortality. Feed contaminated with 0.17 ug Cd/g.
1979	Thorp, J.H., Giesy, J.P., Wineriter, S.A	Arch Environ Contam Toxicol 08 449-456	Cambarus latimanus	Crayfish	Cadmium	22	MG/KG	Growth	NOED	Combined	Whole Body	Adult	Streams, lakes, swamps, North Carolina to Florida	Feeds on both plant and animal material	No significant difference in length and weight. Feed contaminated with 0.17 ug Cd/g
1984	Dillon TM	Army Corps of Engineers Report Technical Report D-84 2	Cambaridae	Crayfish	Cadmium	22	MG/KG	Growth	NOED				Not Specified	Not Specified	Thorp et al., 1979
1991	Borgmann U, Norwood, W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	23	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water
1991	Borgmann U, Norwood, W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	23	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 0.5 um EDTA

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	24.81	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	24.81	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	25.08	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	25.08	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1995	Couillard Y, PGC Campbell, A Tessier, J Pellerin-Massicotte, JC Auclair	Can J Fish Aquat Sci 52:690-702	Anodonta grandis	Freshwater mussel	Cadmium	25.8	MG/KG	Growth	ED90	Water	Whole Body	Adult	Not Specified	Not Specified	Plastic enclosures within lake-Metallothionein; Control group native to the polluted lake
2004	Redeker ES, R Blust	Environ Sci Tech 38:537-543	Tubifex tubifex	Oligochaete sp	Cadmium	25.85	MG/KG	Mortality	LD20	Water	Whole Body	Adult	Not Specified	Not Specified	Bioaccumulation and effects measured from different experiments run under similar conditions. Data retrieved from amalgamation of % mortalities from effects study and bioaccumulation at those times/concentrations in accumulation study
1990	Heinis, F, Timmermans, K R, and W R Swain	Aquat Toxicol 16:73-86	Glyptotendipes pallens	Midge	Cadmium	26	MG/KG	Growth	LOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	Significant decrease in larval weight and population biomass
1992	Timmermans KR, W Peeters, and M Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Cadmium	27.4	MG/KG	Mortality	LD51	Water	Whole Body	Larval	Not Specified	Not Specified	
1981	Wright DA, JW Frain	Arch Environ Contam Toxicol 10:321-328	Gammarus pulex	Amphipod	Cadmium	27.5	MG/KG	Mortality	LD6	Water	Whole Body	Adult	Not Specified	Not Specified	Treatment had 200 mg/L calcium added
1978	Spehar RL, RL Anderson, JT Fiandt	Environ Pollut 15:195-208	Physa sp.	Snail	Cadmium	28	MG/KG	Survival	ED84	Water	Whole Body	Adult	Not Specified	Not Specified	
1991	Ahsanullah M, AR Williams	Mar Biol 108:59-65	Allorchestes compressa	Amphipod	Cadmium	28	MG/KG	Survival	LOED	Water	Whole Body	Juvenile	Not Specified	Not Specified	
1986	Mirenda RJ	Arch Environ Contam Toxicol 15:401-407	Orconectes virilis	Crayfish	Cadmium	28.46	MG/KG	Mortality	LD100	Water	Whole Body	Adult	Not Specified	Not Specified	Data further partitioned into gill, hepatopancreas, abdominal muscle, carapace, antennal gland; gill had the highest accumulation
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	29.6	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment B Exp_Conc are nominal concentrations
1991	Borgmann U, WP Norwood, IM Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	29.6	MG/KG	Mortality	ED50	Water	Whole Body	Embryo	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water + Sediment B Exp_Conc are nominal concentrations
1990	Heinis, F, K R Timmermans, W R Swain	Aquat Toxicol 16:73-86	Glyptotendipes pallens	Midge	Cadmium	30	MG/KG	Growth	LOED	Water	Whole Body	Larval	Not Specified	Not Specified	PCBs - 41, 512, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184 and 193 in a mixture with equal amounts of each. Dead larvae allowed to depurate overnight in clean water prior to bioconc analysis Weight
1990	Heinis, F, K R Timmermans, W R Swain	Aquat Toxicol 16:73-86	Glyptotendipes pallens	Midge	Cadmium	30	MG/KG	Growth	NOED	Water	Whole Body	Larval	Not Specified	Not Specified	PCBs - 41, 512, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184 and 193 in a mixture with equal amounts of each. Dead larvae allowed to depurate overnight in clean water prior to bioconc analysis Biomass
1991	Borgmann, U, Norwood, W P, and I M Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	30	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water
1982	Poulsen, E, H.U. Riisgard, and F Mohlenberg	Mar Biol 68, 25-29 (1982)	Mytilus edulis	Mussel	Cadmium	30	MG/KG	Growth	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats, may extend to depths over 40 ft	Filter plankton, diatoms, bottom vegetation	
1982	Poulsen, E, H.U. Riisgard, and F Mohlenberg	Mar Biol 68, 25-29 (1982)	Mytilus edulis	Mussel	Cadmium	30	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats, may extend to depths over 40 ft	Filter plankton, diatoms, bottom vegetation	Highest Body Burden Reported
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Mytilus edulis	Mussel	Cadmium	30	MG/KG	Growth	NOED				Intertidal zone on rocks, pilings and flats, may extend to depths over 40 ft	Filter plankton, diatoms, bottom vegetation	Poulsen et al, 1982
2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa	Can J Fish Aquat Sci 58:950-960	Hyalella azteca	Amphipod - Freshwater	Cadmium	30.35	MG/KG	Mortality	LD25	Water	Whole body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used imhoff cones instead
1993	Mersch, J, E Morhain, and C Mouvet	Chemosphere 27(8):1475-1485	Dreissena polymorpha	Mussel - Zebra	Cadmium	32	MG/KG	Mortality	NOED	Combined	Whole Body	NA	Introduced, spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder, phytoplankton, bacteria, fine detrital particles	No increase in mortality
1991	Borgmann, U, Norwood, W P, and I M Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	32	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 20mg/l Humic Acid
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	37.18	MG/KG	Growth	ED20	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	37.18	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
1991	Borgmann, U, Norwood, W P, and I M Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	38	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water
1991	Borgmann, U, Norwood, W P, and I M Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	39	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 20mg/l Humic Acid
1991	Borgmann, U, Norwood, W P, and I M Babirad	Can J Fish Aquat Sci 48:1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	39	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 0.5 um EDTA
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	41.49	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24:902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	41.49	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2004	Redeker ES, R Blust	Environ Sci Tech 38:537-543	Tubifex tubifex	Oligochaete sp.	Cadmium	41.59	MG/KG	Mortality	LD50	Water	Whole Body	NS	Not Specified	Not Specified	Model predicted output value= 032 umol/g ww (35.97 mg/kg), uptake rates followed Michaelis-Menten uptake model (2 compartment). Enserink, daphnid LD50= 0.98 umol/g ww. Borgmann, H azteca LD50= 0.68-0.17 umol/g ww
2004	Redeker ES, R Blust	Environ Sci Tech 38:537-543	Tubifex tubifex	Oligochaete sp.	Cadmium	41.59	MG/KG	Mortality	LD50	Water	Whole Body	NS	Not Specified	Not Specified	

Table E-2
ERED Results for Benthic Organisms. Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2004	Redeker ES, R Blust	Environ Sci Tech 38 537 543	Tubifex tubifex	Oligochaete sp	Cadmium	41 59	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Not Specified	Not Specified	Bioaccumulation and effects measured from different experiments run under similar conditions Data retrieved from amalgamation of % mortalities from effects study and bioaccumulation at those times/concentrations in accumulation study
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	41 8	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	41 8	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
1991	Borgmann U Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055 1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	42	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Mad 90% Distilled Water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902 908	Hyalella azteca	Amphipod - Freshwater	Cadmium	42 92	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	42 92	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1991	Borgmann U, Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	44	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 20mg/l Humic Acid
1991	Borgmann U, Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	44	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tap Water With 0 5 um EDTA
1992	Timmermans KR W Peeters and M Tonkes	Hydrobiologia 241 119-134	Chironomus riparius	Midge	Cadmium	46 8	MG/KG	Mortality	LD68	Water	Whole Body	Larval	Not Specified	Not Specified	
1991	Borgmann U Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	47	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment A
1988	Abel, T and F. Barlocher	Journal of Applied Ecology, 25 223 231	Gammarus fossarum	Amphipod	Cadmium	48 4	MG/KG	Mortality	LOED	Ingestion	Whole Body	Adult	Not Specified	Not Specified	Increase in mortality Soft water 4 4 mg/L Ca ion, pH 7 2 Artificial stream system
1981	Wright DA, JW Frain	Arch Environ Contam Toxicol 10 321-328	Gammarus pulex	Amphipod	Cadmium	48 6	MG/KG	Mortality	LD48	Water	Whole Body	Adult	Not Specified	Not Specified	Treatment had 20 mg/L calcium added
2005	Stanley JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	49 87	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	49 87	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab reconstituted water
1990	Heinis, F, K R Timmermans W R Swain	Aquat Toxicol 16 73-86	Glyptotendipes pallens	Midge	Cadmium	50	MG/KG	Growth	LOED	Water	Whole Body	Larval	Not Specified	Not Specified	PCBs - 41 512 60 66 91 99 104, 112 115 126 143 153 169, 184 and 193 in a mixture with equal amounts of each Dead larvae allowed to depurate overnight in clean water prior to bioconc analysis Biomass
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	50 84	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	50 84	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1983	Ferard JF JM Jouany R Truhaut P Vasseur	Ecotoxicol Environ Saf 07 43 52	Daphnia magna	Water flea	Cadmium	51 6	MG/KG	Mortality	LD83	Ingestion	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Fed Cadmium exposed Chlorella vulgaris
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24·902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	52 74	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24.902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	52 74	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1988	Abel, T and F Barlocher	Journal of Applied Ecology, 25 223-231	Gammarus fossarum	Amphipod	Cadmium	52 8	MG/KG	Mortality	LOED	Ingestion	Whole Body	Adult	Not Specified	Not Specified	Increase in mortality Hard water 83-87 mg/L Ca ion pH 8 3 Artificial stream system
1988	Abel, T and F Barlocher	Journal of Applied Ecology, 25 223-231	Gammarus fossarum	Amphipod	Cadmium	53 4	MG/KG	Mortality	LOED	Water	Whole Body	Adult	Not Specified	Not Specified	Increase in mortality Soft water 4 4 mg/L Ca ion, pH 7 2 Artificial stream system.
1988	Abel, T and F Barlocher	Journal of Applied Ecology, 25 223-231	Gammarus fossarum	Amphipod	Cadmium	53 4	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	No increase in mortality Hard water 83-87 mg/L Ca ion pH 8 3 Artificial stream system
1981	Wright DA, JW Frain	Arch Environ Contam Toxicol 10.321-328	Gammarus pulex	Amphipod	Cadmium	58.4	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Not Specified	Not Specified	Treatment had no calcium added
1988	Jenkins KD, AZ Mason	Aquat Toxicol 12 229 244	Neanthes arenaceodentata	Neanthes	Cadmium	60 7	MG/KG	Reproduction	ED100	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	# of eggs
1988	Jenkins KD, AZ Mason	Aquat Toxicol 12 229 244	Neanthes arenaceodentata	Neanthes	Cadmium	60 7	MG/KG	Reproduction	LOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Time pairing to laying of eggs
1988	Jenkins KD, AZ Mason	Aquat Toxicol 12 229-244	Neanthes arenaceodentata	Neanthes	Cadmium	60 7	MG/KG	Survival	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	
1991	Borgmann U, Norwood, W P and I M Babirad	Can J Fish Aquat Sci 48.1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	62	MG/KG	NA	NOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment B
1988	Jenkins, K D and A Z Mason	Aquat Toxicol 12.229-244	Nereis arenaceodentata	Polychaete	Cadmium	62	MG/KG	Reproduction	ED100	Absorption	Whole Body	NA	Cape Cod to Cape Halleras burrows in soft substrata	Predator on small invertebrates	Reproductive failure No eggs produced
2004	Redeker ES, R Blust	Environ Sci Tech 38 537 543	Tubifex tubifex	Oligochaete sp	Cadmium	67 45	MG/KG	Mortality	LD90	Water	Whole Body	Adult	Not Specified	Not Specified	Bioaccumulation and effects measured from different experiments run under similar conditions Data retrieved from amalgamation of % mortalities from effects study and bioaccumulation at those times/concentrations in accumulation study
2005	Stanley JK; BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	71 15	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley JK BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	71 15	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1993	Meador JP	J Exp Mar Biol Eco	Eohaustorius estuarius	Amphipod	Cadmium	72	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft	Omnivore plants, detritus	Animals held 17 d

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1990	Hamis, F, K R Timmermans, W R Swain	Aquat Toxicol 16 73-86	Glyptotendipes pallens	Midge	Cadmium	74	MG/KG	Mortality	NOED	Water	Whole Body	Larval	Not Specified	Not Specified	PCBs 41 512, 60, 68, 91, 99, 104, 112, 115, 126, 143, 153, 169, 184 and 193 in a mixture with equal amounts of each Dead larvae allowed to depurate overnight in clean water prior to bioconc analysis
1991	Borgmann U Norwood, W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	76	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Med 90% Distilled Water
1991	Borgmann U Norwood W P, and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	79	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Med 90% Distilled Water
1992	Timmermans KR W Peeters, and M Tonkes	Hydrobiologia 241 119-134	Chironomus riparius	Midge	Cadmium	80	MG/KG	Growth	ED45	Water	Whole Body	Larval	Not Specified	Not Specified	
1993	Meador JP	J Exp Mar. Biol Eco	Eohaustorius estuarius	Amphipod	Cadmium	86	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft	Omnivore-plants, detritus	Animals held 17 d
1991	Borgmann U Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	86	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment A
1991	Borgmann U., Norwood W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	87	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment A
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	96 74	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
1991	Borgmann U Norwood, W P and I M Babirad	Can J Fish Aquat Sci 48 1055-1060	Hyalella azteca	Amphipod Freshwater	Cadmium	98	MG/KG	Mortality	ED50	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment B
1994	Kraak M H S M Toussaint D Lavy and C Davids	Environ Pollut 084,139-143	Dreissena polymorpha	Mussel - Zebra	Cadmium	100	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Introduced spread to all Great Lakes, some rivers in Atlantic Mississippi drainage basins attaches to rocks other hard surface	Filter feeder, phytoplankton bacteria, fine detrital particles	No increase in mortality Residue was determined from graph and is approximate
1988	Abel T and F Barlocher	Journal of Applied Ecology, 25 223-231	Gammarus fossarum	Amphipod	Cadmium	101 6	MG/KG	Mortality	LOED	Water	Whole Body	Adult	Not Specified	Not Specified	Increase in mortality Hard water 83-87 mg/L Ca ion pH 8.3 Artificial stream system.
1992	Kraak, M H S D Lavy W M H Peeters, and C Davids	Arch Environ Contam Toxicol 23 363-369	Dreissena polymorpha	Mussel - Zebra	Cadmium	108	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Introduced spread to all Great Lakes some rivers in Atlantic, Mississippi drainage basins attaches to rocks other hard surface	Filter feeder, phytoplankton bacteria, fine detrital particles	50% Mortality in 27 days
2005	Stanley, JK, BW Brooks. TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	109 77	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24.902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	109 77	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	mesocosm
1983	Ferard JF, JM Jouany R Truhaut P Vasseur	Ecotoxicol Environ Saf 07 43-52	Chlorella vulgaris	Algae - Green	Cadmium	114	MG/KG	Mortality	NOED	Water	Whole Body	NA	Cosmopolitan, Needs stable surface on which to grow	Not applicable	
1992	Kraak M H S D Lavy W M H Peeters and C Davids	Arch Environ Contam Toxcol 23 363-369	Dreissena polymorpha	Mussel - Zebra	Cadmium	114	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Introduced spread to all Great Lakes some rivers in Atlantic Mississippi drainage basins, attaches to rocks, other hard surface	Filter feeder phytoplankton, bacteria fine detrital particles	No increase in mortality
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	126 2	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	126 2	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod Freshwater	Cadmium	126 2	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1990	Hamis F, K R Timmermans, W R Swain	Aquat Toxicol 16 73 86	Glyptotendipes pallens	Midge	Cadmium	138	MG/KG	Mortality	LOED	Water	Whole Body	Larval	Not Specified	Not Specified	PCBs 41 512 60 68 91, 99, 104, 112 115 126 143, 153 169, 184 and 193 in a mixture with equal amounts of each Dead larvae allowed to depurate overnight in clean water prior to bioconc analysis
1990	Hamis F Timmermans, K R and W R Swain	Aquat Toxicol 16 73 86	Glyptotendipes pallens	Midge	Cadmium	140	MG/KG	Mortality	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No Effect On Mortality in 96 Hours
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	142 6	MG/KG	Growth	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
2005	Stanley, JK, BW Brooks, TW LaPoint	Environ Tox & Chem 24 902-908	Hyalella azteca	Amphipod - Freshwater	Cadmium	142 6	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Lab effluent
1991	Borgmann U Norwood. W P and I M Babirad	Can J Fish Aquat Sci 48 1055 1060	Hyalella azteca	Amphipod - Freshwater	Cadmium	148	MG/KG	NA	LOED	Ingestion	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Sediment B
1982	Carr, R S, and J M Neff	Aquat Toxicol 02 319-333.	Nereis virens	Polychaete Sandworm	Cadmium	150	MG/KG	Growth	NOED	Absorption	Whole Body	Adult	Labrador to southern New England; northern coasts of Europe and Great Britain; intertidal to subtidal; under rocks in burrows	Feeds on worms and other small invertebrates	No significant effect on weight
1992	Kraak M H S D Lavy W M H Peeters and C Davids	Arch Environ Contam Toxicol 23:363-369	Dreissena polymorpha	Mussel Zebra	Cadmium	160	MG/KG	Mortality	LD96	Absorption	Whole Body	Adult	Introduced, spread to all Great Lakes some rivers in Atlantic, Mississippi drainage basins, attaches to rocks, other hard surface	Filter feeder, phytoplankton bacteria, fine detrital particles	96% Mortality in 27 days
1988	Abel, T and F Barlocher	Journal of Applied Ecology, 25.223-231	Gammarus fossarum	Amphipod	Cadmium	216	MG/KG	Mortality	LD100	Water	Whole Body	Adult	Not Specified	Not Specified	100% Mortality in 10 days Soft water 4 4 mg/L Ca ion, pH 7 2 Artificial stream system
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Moina macrocopa	Cladoceran	Cadmium	225	MG/KG	Growth	NOED				Not Specified	Not Specified	Hatakeyama and Yasuno, 1981
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Moina macrocopa	Cladoceran	Cadmium	225	MG/KG	Reproduction	NOED				Not Specified	Not Specified	Hatakeyama and Yasuno, 1981, # of young
2002	Gillis, P L L C Diener T B Reynoldson, D G Dixon	Environ Tox & Chem 21(9) 1836-1844	Chironomus riparius	Midge	Cadmium	236 1	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	
2002	Gillis, P L L C Diener, T B Reynoldson D G.Dixon	Environ Tox & Chem 21(9) 1836-1844	Chironomus riparius	Midge	Cadmium	236 1	MG/KG	Growth	ED43	Combined	Whole Body	Adult	Not Specified	Not Specified	Weight
1991	Carlson A R, G L Phipps V R Mattson P A Kosian and A M Cotter	Environ Tox & Chem 10 1309-1319	Helisoma sp	Snail	Cadmium	300	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Not Specified	Not Specified	No Effect On Mortality
1991	Carlson A R, G L Phipps, V R Mattson P A Kosian and A M Cotter	Environ Tox & Chem 10:1309-1319	Lumbriculus variegatus	Oligochaete	Cadmium	310	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Most of North America, Europe, Ponds, lakes, on top of mud	Feeds on small animals in substrata	No Effect On Mortality
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84 2	Moina macrocopa	Cladoceran	Cadmium	450	MG/KG	Growth	NOED				Not Specified	Not Specified	Hatakeyama and Yasuno, 1981
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84 2	Moina macrocopa	Cladoceran	Cadmium	450	MG/KG	Reproduction	LOED				Not Specified	Not Specified	Hatakeyama and Yasuno 1981, decreased # of young

Table E-2
ERED Results for Benthic Organisms: Cadmium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1991	Carlson, A.R., G.L. Phipps, V.R. Mattson, P.A. Kosian and A.M. Cotter	Environ Tox & Chem 10:1309-1319.	Helisoma sp.	Snail	Cadmium	460	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Not Specified	Not Specified	No Effect On Mortality
1977	Gillespie, R., T. Reisine and E.J. Massaro	Environ Res 13:364-36.	Orconectes propinquus	Crayfish	Cadmium	534	MG/KG	Mortality	NOED	Absorption	Whole Body	NA	Not Specified	Not Specified	No significant difference in mortality. Only 1 of 15 dead at end of exposure period.
1977	Gillespie R, T Reisine, EJ Massaro	Environ Res 13:364-368	Orconectes propinquus	Crayfish	Cadmium	540	MG/KG	Survival	NOED	Water	Whole Body	NS	Not Specified	Not Specified	Onconectes propinquus propinquus initial weight 0.2-1.5g
1991	Carlson, A.R., G.L. Phipps, V.R. Mattson, P.A. Kosian and A.M. Cotter	Environ Tox & Chem 10:1309-1319.	Helisoma sp.	Snail	Cadmium	625	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Not Specified	Not Specified	50% Mortality
1991	Carlson, A.R., G.L. Phipps, V.R. Mattson, P.A. Kosian and A.M. Cotter	Environ Tox & Chem 10:1309-1319.	Lumbriculus variegatus	Oligochaete	Cadmium	670	MG/KG	Mortality	LD40	Absorption	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	40% Mortality
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	2635	MG/KG	Reproduction	ED16	Combined	Whole Body	Adult	Not Specified	Not Specified	Number of Cocoons
1993	Meador JP	J Exp. Mar. Biol. Eco.	Eohaustorius estuarius	Amphipod	Cadmium	3250	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft.	Omnivore-plants, detritus	Animals held 121 d; significantly different than test w/shorter holding time.
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	3415	MG/KG	Reproduction	LOED	Combined	Whole Body	Adult	Not Specified	Not Specified	# Young
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	3415	MG/KG	Reproduction	ED28	Combined	Whole Body	Adult	Not Specified	Not Specified	# Young
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	3617	MG/KG	Reproduction	ED23	Combined	Whole Body	Adult	Not Specified	Not Specified	Number of Cocoons(all significant above this concentration)
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	3617	MG/KG	Reproduction	LOED	Combined	Whole Body	Adult	Not Specified	Not Specified	Number of Cocoons(all significant above this concentration)
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	4554	MG/KG	Reproduction	ED53	Combined	Whole Body	Adult	Not Specified	Not Specified	# Young
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	4554	MG/KG	Reproduction	ED91	Combined	Whole Body	Adult	Not Specified	Not Specified	# of cocoons
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	4554	MG/KG	Reproduction	IP163	Combined	Whole Body	Adult	Not Specified	Not Specified	MTLP concentration increase
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	4554	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	MTLP concentration increase
2002	Gillis, P.L., L.C. Diener, T.B. Reynoldson, D.G.Dixon	Environ Tox & Chem 21(9):1836-1844	Tubifex tubifex	Oligochaete sp.	Cadmium	4554	MG/KG	Reproduction	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	# of cocoons that hatched
1993	Meador JP	J Exp. Mar. Biol. Eco.	Eohaustorius estuarius	Amphipod	Cadmium	4600	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft.	Omnivore-plants, detritus	Animals held 17 d
1993	Meador JP	J Exp. Mar. Biol. Eco.	Eohaustorius estuarius	Amphipod	Cadmium	5550	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Sand and muddy sand bottoms of intertidal zones, to about 50 ft.	Omnivore-plants, detritus	Animals held 17 d
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	8	MG/KG	Growth	NOED	Absorption	Leaf	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	No Effect On Growth
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	11.4	MG/KG	Growth	LOED	Absorption	Leaf	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	Reduced Growth Rate, Chlorosis
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	142	MG/KG	Growth	NOED	Absorption	Root	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	No Effect On Growth
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	27.8	MG/KG	Growth	NOED	Absorption	Stem	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	No Effect On Growth
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	49.6	MG/KG	Growth	LOED	Absorption	Stem	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	Reduced Growth Rate, Chlorosis
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Cadmium	262	MG/KG	Growth	LOED	Absorption	Root	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	Reduced Growth Rate, Chlorosis
1980	Cain, J.R., D.C. Paschal and C.M. Hayden	Arch Environ Contam Toxicol 09:9-16	Scenedesmus obliquus	Algae - Freshwater Colonial Green	Cadmium	658	MG/KG	Growth	LOED	Absorption	Whole Body	Cell	Not Specified	Not Specified	Significant inhibition of growth (39% decrease in population doublings).
1980	Cain, J.R., D.C. Paschal and C.M. Hayden	Arch Environ Contam Toxicol 09:9-16	Scenedesmus obliquus	Algae - Freshwater Colonial Green	Cadmium	2340	MG/KG	Growth	LOED	Absorption	Whole Body	Cell	Not Specified	Not Specified	Significant Inhibition Of Growth (27% decrease in population doublings)
1980	Cain, J.R., D.C. Paschal and C.M. Hayden	Arch Environ Contam Toxicol 09:9-16	Scenedesmus obliquus	Algae - Freshwater Colonial Green	Cadmium	3030	MG/KG	Growth	NOED	Absorption	Whole Body	Cell	Not Specified	Not Specified	No Significant Inhibition Of Population Doubling

Table E-3
ERED Results for Benthic Organsisms: Chromium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium	8.35	MG/KG	Growth	ED9	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium VI	9.11	MG/KG	Growth	ED20	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium VI	15.7	MG/KG	Growth	ED20	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium VI	35.6	MG/KG	Growth	ED27	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium	41.2	MG/KG	Growth	ED0	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepriewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Chromium	96.4	MG/KG	Growth	ED34	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2001	Gorbi, G., M.G. Corradi, M. Invidia, M. Bassi	Ecotoxicol Environ Saf 48:36-42	Scenedesmus acutus	algae - Freshwater Unicellular	Chromium	420	MG/KG	Mortality	LD48	Water	Whole Body	NA	Not Specified	Not Specified	Wild strain 80 lux
2001	Gorbi, G., M.G. Corradi, M. Invidia, M. Bassi	Ecotoxicol Environ Saf 48:36-42	Scenedesmus acutus	algae - Freshwater Unicellular	Chromium	680	MG/KG	Mortality	LD21	Water	Whole Body	NA	Not Specified	Not Specified	Cr-tolerant strain 80 lux
2001	Gorbi, G., M.G. Corradi, M. Invidia, M. Bassi	Ecotoxicol Environ Saf 48:36-42	Scenedesmus acutus	algae - Freshwater Unicellular	Chromium	200	MG/KG	Mortality	LD85	Water	Whole Body	NA	Not Specified	Not Specified	Wild strain 3000 lux
2001	Gorbi, G., M.G. Corradi, M. Invidia, M. Bassi	Ecotoxicol Environ Saf 48:36-42	Scenedesmus acutus	algae - Freshwater Unicellular	Chromium	360	MG/KG	Mortality	LD72	Water	Whole Body	NA	Not Specified	Not Specified	Cr-tolerant strain 3000 lux
1989	Poulton, B.C., T.L. Beitinger, and K.W. Stewart	Arch Environ Contam Toxicol 18:594-600	Clioperla clio	Stonefly	Chromium	1.44	MG/KG	Mortality	ED10	Combined	Whole Body	Immature	Not Specified	Not Specified	
1989	Poulton, B.C., T.L. Beitinger, and K.W. Stewart	Arch Environ Contam Toxicol 18:594-600	Clioperla clio	Stonefly	Chromium	1.67	MG/KG	Mortality	ED30	Combined	Whole Body	Immature	Not Specified	Not Specified	
1989	Poulton, B.C., T.L. Beitinger, and K.W. Stewart	Arch Environ Contam Toxicol 18:594-600	Clioperla clio	Stonefly	Chromium	1.84	MG/KG	Mortality	ED50	Combined	Whole Body	Immature	Not Specified	Not Specified	
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	2.547	MG/KG	Reproduction	ED153	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Increased Brood
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	4.418	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	End_lifestage is 1st generation Larval Decreased Brood
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Neanthes arenaceodentata	Neanthes	Chromium	4.42	MG/KG	Reproduction	NOED				Not Specified	Feeds on living and dead animals	Oshida and Word, 1982
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	6.03	MG/KG	Reproduction	ED35	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	End_lifestage is 1st generation Larval Decreased Brood
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	6.03	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	End_lifestage is 1st generation Larval Time to Spawn
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	8.278	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Decreased Brood
1982	Oshida PS, LS Word	Mar Environ Res 07:167-174	Neanthes arenaceodentata	Neanthes	Chromium	8.278	MG/KG	Reproduction	NOED	Water	Whole Body	Adult	Not Specified	Feeds on living and dead animals	Time to Spawn
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Neanthes arenaceodentata	Neanthes	Chromium	8.28	MG/KG	Reproduction	LOED				Not Specified	Feeds on living and dead animals	Oshida and Word, 1982, # of young (2ndgen)

Table E-4
ERED Results for Benthic Organsims: Mercury

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2000	Beckvar N, S Salazar, M Salazar, and K Finkelstein	Can J Fish Aquat Sci 57:1103-1112	Elliptio complanata	Eastern Elliptio	Mercury	0.19	MG/KG	Growth	ED92	NS		Adult	Not Specified	Not Specified	Reduced growth rate. Ref station negated, using dnstream sta as comparison (sta 8) Elevated Cr and Pb; signif correlation Hg-Cr; moderately associated w organic C.
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	0.859	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	0.859	MG/KG	Reproduction	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No significant difference in number of neonates produced in 21 days.
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	1.53	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	1.53	MG/KG	Reproduction	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No significant difference in number of neonates produced in 21 days.
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	1.64	MG/KG	Reproduction	ED35	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	35% Reduction In Number Of Neonates Produced In 21 Days
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	1.64	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou	Environ Tox & Chem	Hexagenia rigida	Mayfly-Burrowing	Mercury	2	MG/KG	Growth	NOED	Combined	Whole Body	Nymph	Not Specified	Not Specified	No significant difference in weight gain. Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou	Environ Tox & Chem	Hexagenia rigida	Mayfly-Burrowing	Mercury	2	MG/KG	Mortality	NOED	Combined	Whole Body	Nymph	Not Specified	Not Specified	Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	2.33	MG/KG	Reproduction	LOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	32% Reduction In Number Of Neonates Produced In 21 Days
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	2.33	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou	Environ Tox & Chem	Hexagenia rigida	Mayfly-Burrowing	Mercury	2.7	MG/KG	Growth	NOED	Combined	Whole Body	Nymph	Not Specified	Not Specified	No significant difference in weight gain. Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
1994	Odin, M., Ferutet-Mazel, A., Ribeyre, F. and A. Boudou	Environ Tox & Chem	Hexagenia rigida	Mayfly-Burrowing	Mercury	2.7	MG/KG	Mortality	NOED	Combined	Whole Body	Nymph	Not Specified	Not Specified	Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
1983	Niimi, A.J. and C.Y. Cho.	Wat. Res. 17(12):1791-1795.	Daphnia magna	Water flea	Mercuric Chloride	3.052	MG/KG	Reproduction	NOED	Water	Whole Body	Juvenile	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	
1983	Niimi, A.J. and C.Y. Cho.	Wat. Res. 17(12):1791-1795.	Daphnia magna	Water flea	Mercuric Chloride	4.656	MG/KG	Reproduction	ED32	Water	Whole Body	Juvenile	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	
1983	Niimi, A.J. and C.Y. Cho.	Wat. Res. 17(12):1791-1795.	Daphnia magna	Water flea	Mercuric Chloride	4.656	MG/KG	Mortality	NOED	Water	Whole Body	Juvenile	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	4.67	MG/KG	Reproduction	ED62	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	62% Reduction In Number Of Neonates Produced In 21 Days
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	4.67	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	7.57	MG/KG	Reproduction	ED63	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	63% Reduction In Number Of Neonates Produced In 21 Days
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	7.57	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia magna	Water flea	Mercury	15.26	MG/KG	Reproduction	NOED				Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Biesinger et al., 1982, # of young
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	18.4	MG/KG	Mortality	ED25	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	25% Reduction In Survival Compared To Controls In 21 Days
1982	Biesinger, K.E., L.E. Anderson and J.G. Eaton	Arch Environ Contam Toxicol 11:769-774.	Daphnia magna	Water flea	Mercury	18.4	MG/KG	Reproduction	ED99	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	99% Reduction In Number Of Neonates Produced In 21 Days
1984	Dillon TM	Army Corps of Engineers Report Technical Report, D-84-2	Daphnia magna	Water flea	Mercury	23.28	MG/KG	Reproduction	LOED				Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Biesinger et al., 1982, # of young
2003	Vidal DE, AJ Horne	Arch Environ Contam Toxicol 45:184-189	Sparganophilus pearsei		Mercury	29.2	MG/KG	Mortality	LD50	Water	Whole Body	NS	NS	NS	Worms field collected in from 5 areas in San Francisco vicinity: Lake Anza
2003	Vidal DE, AJ Horne	Arch Environ Contam Toxicol 45:184-189	Sparganophilus pearsei		Mercury	36.4	MG/KG	Mortality	LD50	Water	Whole Body	NS	NS	NS	Worms field collected in from 5 areas in San Francisco vicinity: San Pablo
1986	Rossaro, B., G.F. Gaggino, and R. Marchetti.	Bull Environ Contam Toxicol 37:402-406	Chironomus riparius	Midge	Mercury	40	MG/KG	Mortality	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No mortality. No effect on emergence of adults.
1986	Rossaro, B., G.F. Gaggino, and R. Marchetti.	Bull Environ Contam Toxicol 37:402-406	Chironomus riparius	Midge	Mercury	88	MG/KG	Mortality	NOED	Absorption	Pupal Exuviae	Larval	Not Specified	Not Specified	No mortality in 4th instar larvae.
2003	Vidal DE, AJ Horne	Arch Environ Contam Toxicol 45:184-189	Sparganophilus pearsei		Mercury	90.6	MG/KG	Mortality	LD50	Water	Whole Body	NS	NS	NS	Worms field collected in from 5 areas in San Francisco vicinity: Lake Herman
1986	Rossaro, B., G.F. Gaggino, and R. Marchetti.	Bull Environ Contam Toxicol 37:402-406	Chironomus riparius	Midge	Mercury	107.6	MG/KG	Mortality	NOED	Absorption	Whole Body	Larval	Not Specified	Not Specified	No mortality in 4th instar larvae.

Table E-4
ERED Results for Benthic Organsims: Mercury

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2003	Vidal DE, AJ Horne	Arch Environ Contam Toxicol 45:184-189	Sparganophilus pearsei		Mercury	127	MG/KG	Mortality	LD50	Water	Whole Body	NS	NS	NS	Worms field collected in from 5 areas in San Francisco vicinity: Guadalupe

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2004	Bennicelli R, Z Stepniewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Mercuric Chloride	7.08	MG/KG	Growth	ED23	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepniewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Mercuric Chloride	30.6	MG/KG	Growth	ED31	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content
2004	Bennicelli R, Z Stepniewska, A banach, K Szajnocha, J Ostrowski	Chemosphere 55: 141-146	Azolla caroliniana	Carolina mosquito fern	Mercuric Chloride	57.8	MG/KG	Growth	ED28	Water	Leaf	Adult	Eastern US	Not Specified	Conversion from dry wt to wet wt based on 90% moisture content

Table E-5
ERED Results for Benthic Organisms: Lead

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	104	MG/KG	Mortality	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	0ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	104	MG/KG	Growth	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 0ppt also exposed to Zn and Cu Chironomus maddeni
1993	Maclean, R.S., U. Borgmann and D.G. Dixon	Poster P418, 14th Annual Meeting, SETAC Houston	Hyalella azteca	Amphipod - Freshwater	Lead	115	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	50% Mortality (estimate). Pre-exposed to 100 nM Pb for 4 weeks.
2002	Chinni, S., R.N. Khan, P.R. Yallapragada	Ecotoxicol Environ Saf 51:79-84	Penaeus indicus	copepod	Lead	118	MG/KG	Mortality	LD10	Water	Whole Body	Juvenile	Eastern US	Feeds on Algae	BB that are significantly different from controls and that produce 10% mortality.
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	124	MG/KG	Mortality	ED85	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	8ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	124	MG/KG	Growth	ED65	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 8ppt also exposed to Zn and Cu Chironomus maddeni
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	130.328	MG/KG	Survival	LOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	150.84	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc. **10-16 wk old
1993	Maclean, R.S., U. Borgmann and D.G. Dixon	Poster P418, 14th Annual Meeting, SETAC Houston	Hyalella azteca	Amphipod - Freshwater	Lead	160	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	50% Mortality (estimate).
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	170	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Lead	200	MG/KG	Growth	LOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	Decreased weight gain in surviving mussels.
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Lead	200	MG/KG	Mortality	LOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	52% Mortality
2002	Chinni, S., R.N. Khan, P.R. Yallapragada	Ecotoxicol Environ Saf 51:79-84	Penaeus indicus	copepod	Lead	200	MG/KG	Mortality	LD25	Water	Whole Body	Juvenile	Eastern US	Feeds on Algae	BB that are significantly different from control and that produced significant increase in mortality.
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	220	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	269	MG/KG	Mortality	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	0ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	269	MG/KG	Growth	ED50	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 0ppt also exposed to Zn and Cu Chironomus maddeni
1992	Timmermans KR, W Peeters, and M. Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Lead	280	MG/KG	Growth	ED29	Water	Whole Body	Larval	Not Specified	Not Specified	
1992	Timmermans KR, W Peeters, and M. Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Lead	280	MG/KG	Growth	ED29	Water	Whole Body	Larval	Not Specified	Not Specified	
2002	Chinni, S., R.N. Khan, P.R. Yallapragada	Ecotoxicol Environ Saf 51:79-84	Penaeus indicus	copepod	Lead	300	MG/KG	Mortality	LD50	Water	Whole Body	Juvenile	Eastern US	Feeds on Algae	BB that are significantly different from control and that produced significant increase in mortality.
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	300	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
2004	Mann RM, M Grosell, A Bianchini, CM Wood	Environ Tox & Chem 23:388-395	Chironomus tentans	Midge	Lead	481	MG/KG	Growth	NOED	Combined	Whole Body	Egg	Northern U.S,southern Canada; widely distributed on bottoms of streams, lakes, ponds	Larvae feed on microorganisms, small animals in sediments, detritus; adults non-feeding	Results are from a mixture of zinc and lead.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	4.4	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Total Mass.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	4.4	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Total leaf area.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	4.4	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Seedling Height
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	4.4	MG/KG	Growth	NOED	Combined	Leaf	Yearling	Littoral		Emergence
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	240	MG/KG	Growth	NOED	Combined	Root	Yearling	Littoral		Emergence.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	240	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Seedling Height.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	240	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Total Leaf Area.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Lead	240	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Total Mass.
1984	Kay, S.H., W.T. Haller and L.A. Garrard	Aquat Toxicol 05:117-128.	Eichhornia crassipes	Water Hyacinth	Lead	1030	MG/KG	Growth	NOED	Absorption	Root	NA	Introduced into southeastern US; occurs mainly in sheltered sites on standing and slow-flowing water	Not applicable	No Effect On Growth

Table E-5
ERED Results for Benthic Organisms: Lead

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Biomphalaria glabrata	Biomphalaria glabrata	Lead	5	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
1999	Borgmann U, WP Norwood	Can J Fish Aquat Sci 56:1494-1503	Hyalella azteca	Amphipod - Freshwater	Lead	5.22	MG/KG	Mortality	LD25	Absorption	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Field-collected sediment
1999	Borgmann U, WP Norwood	Can J Fish Aquat Sci 56:1494-1503	Hyalella azteca	Amphipod - Freshwater	Lead	6.71	MG/KG	Mortality	LD50	Absorption	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Field-collected sediment
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	10	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Biomphalaria glabrata	Biomphalaria glabrata	Lead	20	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa	Can J Fish Aquat Sci 58:950-960	Hyalella azteca	Amphipod - Freshwater	Lead	26.107	MG/KG	Mortality	LD25	Water	Whole body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	30	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Biomphalaria glabrata	Biomphalaria glabrata	Lead	32	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Lead	35	MG/KG	Growth	NOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No effect on weight gain in surviving mussels.
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Lead	35	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No Effect On Mortality
1992	Bleeker, EAJ, MHS Kraak, C Davids.	Hydrobiol Bull 25: 233-235	Dreissena polymorpha	Mussel - Zebra	Lead	40	MG/KG	Mortality	NOED	Water	Other	Immature	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	~1.78cm initial length Fraction = Soft Tissues
1978	Spehar RL, RL Anderson, JT Fiandt	Environ Pollut 15:195-208	Gammarus pseudolimnaeus	Amphipod	Lead	40	MG/KG	Mortality	LD61	Water	Whole Body	Adult	Not Specified	Not Specified	[log scale--difficult to interpret]
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Biomphalaria glabrata	Biomphalaria glabrata	Lead	40	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Calanus hyperboreus	Calanoid copepod	Lead	40.7	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	Clearly written paper
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	44.755	MG/KG	Survival	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	48.277	MG/KG	Survival	NOED	Water	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	58.844	MG/KG	Survival	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Lumbriculus variegatus	Oligochaete	Lead	60	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Most of North America, Europe; Ponds, lakes, on top of mud	Feeds on small animals in substrata	
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Themisto libellula	Mesoplankton amphipod	Lead	63.3	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Themisto abyssorum	Mesoplankton amphipod	Lead	63.3	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	68.376	MG/KG	Survival	LOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
1993	Maclean, R.S., U. Borgmann and D.G. Dixon	Poster P418, 14th Annual Meeting, SETAC Houston	Hyalella azteca	Amphipod - Freshwater	Lead	70	MG/KG	Mortality	LD50	Absorption	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	50% Mortality (estimate).
2002	Chinni, S., R.N. Khan, P.R. Yallapragada	Ecotoxicol Environ Saf 51:79-84	Penaeus indicus	copepod	Lead	70	MG/KG	Mortality	NOED	Water	Whole Body	Juvenile	Eastern US	Feeds on Algae	BB that are significantly different from control and that did not produce significant increase in mortality.
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	72	MG/KG	Mortality	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	4ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	72	MG/KG	Mortality	ED28	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	4ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	72	MG/KG	Growth	ED29	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 4ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	72	MG/KG	Growth	ED62	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 4ppt also exposed to Zn and Cu Chironomus maddeni
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	72.31	MG/KG	Mortality	LD50	Water	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	82.67	MG/KG	Survival	LOED	Water	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	82.88	MG/KG	Survival	NOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Result of modelling mortality rates vs Pb conc.
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	83	MG/KG	Mortality	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	4ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Lead	83	MG/KG	Growth	ED33	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 4ppt also exposed to Zn and Cu Chironomus maddeni
2005	Aisemberg J; DE Nahabedian; EA Wider; NRV Guerrero	Toxicology 210:45-53	Biomphalaria glabrata	Biomphalaria glabrata	Lead	85	MG/KG	Mortality	NOED	Water	Whole Body	Adult	Not Specified	Not Specified	
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	85.78	MG/KG	Survival	LOED	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	89.92	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: Without pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
1993	Maclean, R.S., U. Borgmann and D.G. Dixon	Poster P418, 14th Annual Meeting, SETAC Houston	Hyalella azteca	Amphipod - Freshwater	Lead	90	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	50% Mortality (estimate).
1996	MacLean RS, U Borgmann, and DG Dixon	Can J Fish Aquat Sci 53:2212-2220	Hyalella azteca	Amphipod - Freshwater	Lead	101.53	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Tests run with 4-5 wk old amphipods: With pre-exposure to 100nM Pb. Result of modelling mortality rates vs Pb conc.
1978	Spehar RL, RL Anderson, JT Fiandt	Environ Pollut 15:195-208	Gammarus pseudolimnaeus	Amphipod	Lead	102	MG/KG	Mortality	LD61	Water	Whole Body	Adult	Not Specified	Not Specified	[log scale--difficult to interpret]; no residue data for stoneflies, caddisflies, and snails. Stated that Pb conc.to 565 ug/L did not decrease survival

Table E-6
ERED Results for Benthic Organisms: Selenium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1994	Alaimo, J., R.S. Ogle and A.W. Knight	Arch Environ Contam Toxicol 27:441-448	Chironomus decorus	Midge	Selenium	0.2	MG/KG	Growth	ED40	Combined	Whole Body	Egg	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	40% Decreased body weight
1995	Malchow, D.E., A.W. Knight and K.J. Maier	Arch Environ Contam Toxicol 29:104-109	Chironomus decorus	Midge	Selenium	0.51	MG/KG	Growth	LOED	Ingestion	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	Reduction In Growth (weight)
1994	Alaimo, J., R.S. Ogle and A.W. Knight	Arch Environ Contam Toxicol 27:441-448	Chironomus decorus	Midge	Selenium	2	MG/KG	Growth	ED54	Combined	Whole Body	Egg	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	54% Decreased body weight
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	2.94	MG/KG	Growth	ED105	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Stimulatory effect on size of offspring (body length of offspring) [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	2.94	MG/KG	Biochemical	ED121	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Stimulatory effect on size of offspring (body length of offspring) [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	2.94	MG/KG	Growth	ED24	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Adult [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	2.94	MG/KG	Growth	LOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	24% Decrease in weight gain.
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	2.94	MG/KG	Reproduction	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No effect on number of total young and time to first brood.
1993	Besser, J.M., T.J. Canfield and T.W. Lapoint	Environ Tox & Chem 12:57-72.	Daphnia magna	Water flea	Selenium	3	MG/KG	Growth	LOED	Combined	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Significant increase in biomass over controls - a hormetic effect at lowest dose.
1996	Ogle RS, AW Knight	Arch Environ Contam Toxicol 30:274-279	Daphnia magna	Water flea	Selenium	3.42	MG/KG	Mortality	LD95	Water	Whole Body	Adult	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Tissue concentration was not found to be significant. This mortality was shown at a Sulfate concentration of 0.
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	4.22	MG/KG	Growth	ED104	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Stimulatory effect on size of offspring (body length of offspring) [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	4.22	MG/KG	Growth	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Growth (weight)
1994	Alaimo, J., R.S. Ogle and A.W. Knight	Arch Environ Contam Toxicol 27:441-448	Chironomus decorus	Midge	Selenium	4.4	MG/KG	Growth	ED68	Combined	Whole Body	Egg	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	68% Decreased body weight
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Reproduction	ED11	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Intrinsic rate of natural increase [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Biochemical	ED117	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Stimulatory effect on size of offspring (body length of offspring) [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Growth	ED36	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Adult [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Reproduction	ED47	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Total young produced [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Reproduction	ED47	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Young/AFRD -available female reproductive days [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Reproduction	ED47	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Day first gravid [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Growth	ED36	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	36% Decrease in weight gain.
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	6.34	MG/KG	Reproduction	LOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Decrease in total young and young per female. Delayed time to first brood.
1996	Dobbs, M.G., D.S. Cherry and J. Cairns, Jr.	Environ Tox & Chem 15:340-347	Chlorella vulgaris	Algae - Green	Selenium	9	MG/KG	Growth	LOED	Absorption	Whole Body	NA	Cosmopolitan; Needs stable surface on which to grow	Not applicable	Significant reduction in population biomass.
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Reproduction	ED11	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Intrinsic rate of natural increase [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Reproduction	ED37	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Day first gravid [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Growth	ED42	Water	Whole Body	Larval	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Adult [Survival of daphnids was signif. decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]

Table E-6
ERED Results for Benthic Organisms: Selenium

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09.1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Reproduction	ED71	Water	Whole Body	Larval	Southwestern to south central Canada, Northwestern to north central US, ponds small lakes, clear and weedy waters	Feeds on algae and similar organisms	young/AFRD [Survival of daphnids was signif decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll CG, FJ Dwyer, and TW May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Reproduction	ED72	Water	Whole Body	Larval	Southwestern to south-central Canada Northwestern to north-central US ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Total young produced [Survival of daphnids was signif decreased only at 1,410 ug/L, but no residue information is available for this conc. However, reproductive/development occurred]
1990	Ingersoll, C.G., F.J Dwyer and T.W May	Environ Tox & Chem 09 1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Growth	ED42	Absorption	Whole Body	Immature	Southwestern to south-central Canada Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	42% Decrease in weight gain.
1990	Ingersoll, C.G., F.J. Dwyer and T.W. May	Environ Tox & Chem 09:1171-1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Reproduction	ED70	Absorption	Whole Body	Immature	Southwestern to south-central Canada. Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Over 70% decrease in total young and young per female. Delayed time to first brood
1990	Ingersoll, C.G., F.J Dwyer and T.W May	Environ Tox & Chem 09 1171 1181	Daphnia magna	Water flea	Selenium	10.2	MG/KG	Mortality	NOED	Absorption	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No Effect On Mortality
1996	Dobbs, M.G., D.S Cherry and J Cairns, Jr	Environ Tox & Chem 15:340-347	Brachionus calyciflorus	Rotifer	Selenium	12	MG/KG	Growth	LOED	Combined	Whole Body	NA	Cosmopolitan, shore dweller in temperate ponds, poorly vegetated	Predaceous, feed on small swimming invertebrates, larvae	Significant Reduction In Population Biomass
1993	Maier, K.J and A.W Knight	Arch Environ Contam Toxicol 25:365-370	Chironomus decorus	Midge	Selenium	12.6	MG/KG	Mortality	LD50	Absorption	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	Lethal To 50% Of Animals In 48 Hours
1996	Dobbs, M.G., D.S Cherry and J Cairns, Jr.	Environ Tox & Chem 15:340-347	Brachionus calyciflorus	Rotifer	Selenium	15	MG/KG	Mortality	LD100	Combined	Whole Body	NA	Cosmopolitan, shore dweller in temperate ponds, poorly vegetated	Predaceous, feed on small swimming invertebrates, larvae	100% Mortality In 10 days
1993	Maier, K.J and A.W. Knight	Arch Environ Contam Toxicol 25:365-370	Chironomus decorus	Midge	Selenium	17	MG/KG	Mortality	LD50	Absorption	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	Lethal To 50% Of Animals In 48 Hours
1993	Besser, J.M T J Canfield and T W. Lapoint	Environ Tox & Chem 12 57-72	Daphnia magna	Water flea	Selenium	20.4	MG/KG	Growth	NOED	Combined	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north-central US, ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	No difference in biomass compared to controls.
1993	Besser J.M., T J Canfield and T W Lapoint	Environ Tox & Chem 12:57-72	Daphnia magna	Water flea	Selenium	29.6	MG/KG	Mortality	LOED	Combined	Whole Body	Immature	Southwestern to south-central Canada, Northwestern to north central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Mortality measured as decreased biomass

Table E-7
ERED Results for Benthic Organsims: Zinc

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	11.12	MG/KG	Reproduction	LOED	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	11.12	MG/KG	Reproduction	ED60	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
1986	Mirenda, R.J.	Bull Environ Contam Toxicol 37:387-394	Orconectes virilis	Crayfish	Zinc	12.7	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Not Specified	Not Specified	No significant increase in mortality.
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	16.8	MG/KG	Mortality	NOED	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	16.8	MG/KG	Growth	NOED	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	Growth weight - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	16.8	MG/KG	Reproduction	NOED	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	time to brood - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Daphnia magna	Water flea	Zinc	16.8	MG/KG	Reproduction	ED62	Water	Whole Body	NA	Southwestern to south-central Canada, Northwestern to north-central US; ponds, small lakes, clear and weedy waters	Feeds on algae and similar organisms	# offspring/adult - Argued that 10 organisms/exposure = 10 replicates of 1 organism per concentration
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Mysella anomala	Bivalve	Zinc	18	MG/KG	Mortality	LD28	Combined	Whole Body	Adult	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Mysella anomala	Bivalve	Zinc	18	MG/KG	Mortality	LD62	Combined	Whole Body	Adult	Not Specified	Not Specified	
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	19.5	MG/KG	Mortality	LD25	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Australonereis ehlersi	Polychaete	Zinc	20	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	
2001	Grout, J.A. C.D. Levings	Mar Environ Res 51,265-288	Mytilus edulis	Mussel	Zinc	25	MG/KG	Growth	LOED	Water	Whole Body	Juvenile	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	LOED for growth is based on increase in length of juveniles as well as weight increases.
2001	Grout, J.A. C.D. Levings	Mar Environ Res 51,265-288	Mytilus edulis	Mussel	Zinc	26	MG/KG	Mortality	LOED	Water	Whole Body	Juvenile	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	
2001	Grout, J.A. C.D. Levings	Mar Environ Res 51,265-288	Mytilus edulis	Mussel	Zinc	26	MG/KG	Development	LOED	Water	Whole Body	Juvenile	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	LOED for development is based on the condition index of the surviving juveniles.
2003	St-Jean SD, SC Courtenay, RW Parker	Water Qual Res J Can 38(4):647-666	Mytilus edulis	Mussel	Zinc	26	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	
2003	St-Jean SD, SC Courtenay, RW Parker	Water Qual Res J Can 38(4):647-666	Mytilus edulis	Mussel	Zinc	26	MG/KG	Growth	NOED	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	Length - Growth in test animals increased in direct proportion to proximity to pulpmill effluent plume which was deemed to reflect not the contaminants, but the increased amounts of nutrients.
1991	Ahsanullah M, AR Williams	Mar Biol 108:59-65	Allorchestes compressa	Amphipod	Zinc	28	MG/KG	Growth	LOED	Water	Whole Body	Juvenile	Not Specified	Not Specified	Weight
1991	Ahsanullah M, AR Williams	Mar Biol 108:59-65	Allorchestes compressa	Amphipod	Zinc	28	MG/KG	Survival	LOED	Water	Whole Body	Juvenile	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Mysella anomala	Bivalve	Zinc	30	MG/KG	Mortality	LD65	Combined	Whole Body	Adult	Not Specified	Not Specified	
2001	Martinez EA, BC Moore, J Schaumloffel, N Dasgupta	Environ Tox & Chem 20(11)2475-2481	Chironomus tentans	Midge	Zinc	34.8	MG/KG	Development	LOED	Combined	Whole Body	Egg	Northern U.S,southern Canada; widely distributed on bottoms of streams, lakes, ponds	Larvae feed on microorganisms, small animals in sediments, detritus; adults non-feeding	12% Mouthpart deformities (3% abnormal in controls); Zn concentrations 10 times that of the LOED had fewer deformities.
1986	Mirenda, R.J.	Bull Environ Contam Toxicol 37:387-394	Orconectes virilis	Crayfish	Zinc	35.2	MG/KG	Mortality	LD23	Absorption	Whole Body	Adult	Not Specified	Not Specified	23% Significant increase in mortality.
1986	Mirenda, R.J.	Bull Environ Contam Toxicol 37:387-394	Orconectes virilis	Crayfish	Zinc	37.8	MG/KG	Mortality	LD43	Absorption	Whole Body	Adult	Not Specified	Not Specified	43% increase in mortality.
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	40.3	MG/KG	Mortality	LD25	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann U, WP Norwood	Can J Fish Aquat Sci 54:1055-1063	Hyalella azteca	Amphipod - Freshwater	Zinc	49.04	MG/KG	Mortality	LD25	Combined	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	M1-Tapwater
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	50.2	MG/KG	Mortality	LD50	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	53.6	MG/KG	Mortality	NOED	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann U, WP Norwood	Can J Fish Aquat Sci 54:1055-1063	Hyalella azteca	Amphipod - Freshwater	Zinc	54.9	MG/KG	Mortality	LD45	Combined	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	M3-Tapwater
1988	Kaitala S	Water Sci Tech 20:23-32	Mytilus edulis	Mussel	Zinc	55.8	MG/KG	Survival	NOED	Water	Soft Tissue	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Nephtys australiensis	Polychaete	Zinc	60	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	60.8	MG/KG	Mortality	LD67	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	60.8	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1986	Mirenda, R.J.	Bull Environ Contam Toxicol 37:387-394	Orconectes virilis	Crayfish	Zinc	69.2	MG/KG	Mortality	LD61	Absorption	Whole Body	Adult	Not Specified	Not Specified	61% increase in mortality.
1994	Burbidge, F.J., D.J. Macey, J. Webb and V. Talbot	Arch Environ Contam Toxicol 26:466-472.	Mytilus edulis	Mussel	Zinc	71.4	MG/KG	Mortality	NA	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	7.5% Mortality in 14 Days
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	72.7	MG/KG	Mortality	LD25	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Nephtys australiensis	Polychaete	Zinc	80	MG/KG	Mortality	LD05	Combined	Whole Body	Adult	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Nephtys australiensis	Polychaete	Zinc	80	MG/KG	Mortality	LD07	Combined	Whole Body	Adult	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Tellina deltoidalis	Bivalve	Zinc	80	MG/KG	Mortality	LD10	Combined	Soft tissue	Adult	Not Specified	Not Specified	
1986	Mirenda, R.J.	Bull Environ Contam Toxicol 37:387-394	Orconectes virilis	Crayfish	Zinc	85.6	MG/KG	Mortality	LD23	Absorption	Hepatopancreas	Adult	Not Specified	Not Specified	23% Significant increase in mortality.
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	90.6	MG/KG	Mortality	LD50	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Pseudokirchneriella subcapitata		Zinc	98	MG/KG	Growth	NOED	Water	Whole Body	NA			Rate
2004	De Schamphelaere KAC, M Canli, V Van Lierde, I Forrez, F Vanhaecke, CR Janssen	Aquat Toxicol 70:233-244	Pseudokirchneriella subcapitata		Zinc	98	MG/KG	Growth	NOED	Water	Whole Body	NA			weight

Table E-7
ERED Results for Benthic Organsims: Zinc

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Nephtys australiensis	Polychaete	Zinc	100	MG/KG	Mortality	NOED	Combined	Whole Body	Adult	Not Specified	Not Specified	
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	105.8	MG/KG	Mortality	LD100	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann U, WP Norwood	Can J Fish Aquat Sci 54:1055-1063	Hyalella azteca	Amphipod - Freshwater	Zinc	117.1	MG/KG	Mortality	LD100	Combined	Whole Body	Immature	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	M2-Tapwater
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	117.8	MG/KG	Mortality	LD100	Absorption	Whole Body	Juvenile	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1997	Borgmann, U., and W.P. Norwood	Can J Fish Aquat Sci 54:1046-1054	Hyalella azteca	Amphipod - Freshwater	Zinc	117.8	MG/KG	Mortality	LD40	Absorption	Whole Body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	calc wet from dry using default % moisture
1994	Kraak, M.H.S., M. Toussaint, D. Lavy, and C. Davids.	Environ Pollut 084:139-143.	Dreissena polymorpha	Mussel - Zebra	Zinc	120	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No increase in mortality. Residue was determined from graph and is approximate.
1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	120	MG/KG	Mortality	NOED	Water	Soft Tissue	NS	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	Mussel Bioconcentrations taken as Musssels dies during experiment. Filtration Rate
1994	Burbidge, F.J., D.J. Macey, J. Webb and V. Talbot	Arch Environ Contam Toxicol 26:466-472.	Mytilus edulis	Mussel	Zinc	130	MG/KG	Mortality	LD100	Combined	Whole Body	Adult	Intertidal zone on rocks, pilings and flats; may extend to depths over 40 ft.	Filter plankton, diatoms, bottom vegetation	100% Mortality in 14 Days
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	140	MG/KG	Mortality	NOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No Effect On Mortality
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Soletellina alba	Bivalve	Zinc	160	MG/KG	Mortality	LD70	Combined	Soft tissue	Adult	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Tellina deltoidalis	Bivalve	Zinc	180	MG/KG	Mortality	LD10	Combined	Soft tissue	Adult	Not Specified	Not Specified	
1992	Timmermans KR, W Peeters, and M. Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Zinc	180	MG/KG	Growth	ED44	Water	Whole Body	Larval	Not Specified	Not Specified	Delay in larval growth
1992	Timmermans KR, W Peeters, and M. Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Zinc	183	MG/KG	Mortality	LD10	Water	Whole Body	Larval	Not Specified	Not Specified	
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Tellina deltoidalis	Bivalve	Zinc	250	MG/KG	Mortality	LD65	Combined	Soft tissue	Adult	Not Specified	Not Specified	
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	275	MG/KG	Mortality	ED28	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	4ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	275	MG/KG	Growth	ED62	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 4ppt also exposed to Zn and Cu Chironomus maddeni
2001	Borgmann U, WP Norwood, TB Reynoldson, and F Rosa	Can J Fish Aquat Sci 58:950-960	Hyalella azteca	Amphipod - Freshwater	Zinc	289.023	MG/KG	Mortality	LD25	Water	Whole body	Adult	Widely distributed in North America in permanent bodies of water with submerged vegetation	Detritivore	Water, sed, benthic inverts @ 12 lakes, pH 6.6-8.3. Lab tests w/seds and Hyalella. Beakers lowered pH to 4, used Imhoff cones instead.
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	314	MG/KG	Mortality	ED70	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	8ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	314	MG/KG	Growth	ED59	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 8ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	382	MG/KG	Mortality	NOED	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	0ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	382	MG/KG	Growth	ED50	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 0ppt also exposed to Zn and Cu Chironomus maddeni
2004	King CK, MC Dowse, SL Simpson, DF Jolley	Arch Environ Contam Toxicol 47:314-323	Tellina deltoidalis	Bivalve	Zinc	420	MG/KG	Mortality	LD65	Combined	Soft tissue	Adult	Not Specified	Not Specified	
1992	Timmermans KR, W Peeters, and M. Tonkes	Hydrobiologia 241:119-134.	Chironomus riparius	Midge	Zinc	524	MG/KG	Mortality	LD6	Water	Whole Body	Larval	Not Specified	Not Specified	
1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	600	MG/KG	Mortality	LD100	Water	Soft Tissue	NS	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	Mussel Bioconcentrations taken as Musssels dies during experiment. Filtration Rate
1994	Kraak MHS, YA Wink, SC Stuijfzand, MC Buckert-de Jung, CJ de Groot, W Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	620	MG/KG	Mortality	LD50	Water	Soft Tissue	NS	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	Mussel Bioconcentrations taken as Musssels dies during experiment.
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	621	MG/KG	Mortality	LOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	56% Mortality
1994	Kraak, M.H.S., Y.A. Wink, S.C. Stuijfzand, M.C. Buckert-de Jong, C.J. De Groot and W. Admiraal	Aquat Toxicol 30:77-89	Dreissena polymorpha	Mussel - Zebra	Zinc	621	MG/KG	Growth	NOED	Absorption	Whole Body	Adult	Introduced; spread to all Great Lakes, some rivers in Atlantic, Mississippi drainage basins; attaches to rocks, other hard surface	Filter feeder; phytoplankton, bacteria, fine detrital particles	No Effect On Weight Gain Of Surviving Mussels
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	706	MG/KG	Mortality	ED85	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	8ppt also exposed to Zn and Cu Chironomus maddeni
2006	Bidwell JR, JR Gorrie	Environ Pollut 139-206-213	Chironomus decorus	Midge	Zinc	706	MG/KG	Growth	ED65	Combined	Whole Body	Larval	Bottom dwelling in tubes in shallow ponds or lakes	Adults non-feeding; larvae utilize microorganisms small bits of detritus	growth = dry wt; 8ppt also exposed to Zn and Cu Chironomus maddeni
2004	Mann RM, M Grosell, A Bianchini, CM Wood	Environ Tox & Chem 23:388-395	Chironomus tentans	Midge	Zinc	745	MG/KG	Growth	NOED	Combined	Whole Body	Egg	Northern U.S,southern Canada; widely distributed on bottoms of streams, lakes, ponds	Larvae feed on microorganisms, small animals in sediments, detritus; adults non-feeding	Results are from a mixture of zinc and lead.
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Themisto libellula	Mesoplankton amphipod	Zinc	951	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Themisto abyssorum	Mesoplankton amphipod	Zinc	951	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	
2004	Mann RM, M Grosell, A Bianchini, CM Wood	Environ Tox & Chem 23:388-395	Chironomus tentans	Midge	Zinc	1187	MG/KG	Growth	NOED	Combined	Whole Body	Egg	Northern U.S,southern Canada; widely distributed on bottoms of streams, lakes, ponds	Larvae feed on microorganisms, small animals in sediments, detritus; adults non-feeding	Results are from a mixture of zinc and lead.
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Calanus hyperboreus	Calanoid copepod	Zinc	1750	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	low concentration exposure
1997	Ritterhoff, J., and G-P. Zauke	Aquat Toxicol	Calanus hyperboreus	Calanoid copepod	Zinc	2980	MG/KG	Mortality	LD50	Water	Whole Body	Adult	Open boreal ocean	Omnivore-diatoms, small crustacean	High concentration exposure
2004	Macinnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Eil grass	Zinc	13	MG/KG	Cellular	NOED	NS	Root		NS	NS	Chlorophyll fluorescence, Pittwater
1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Hypnea musciformis	Hypnea musciformis	Zinc	14	MG/KG	Growth	ED80	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	18	MG/KG	Growth	ED29	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA; CS Karez; LR Andrade; Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Enteromorpha flexuosa	Enteromorpha flexuosa	Zinc	20	MG/KG	Growth	ED52	Water	Whole Body	NA	Not Specified	Other	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84	Avicennia marina	Grey Mangrove	Zinc	30	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Total Mass.
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54: 65-84 -	Avicennia marina	Grey Mangrove	Zinc	30	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Emergence

Table E-7
ERED Results for Benthic Organsims: Zinc

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	30	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Seedling Height
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	30	MG/KG	Growth	LOED	Combined	Leaf	Yearling	Littoral		Total Leaf area
2004	MacInnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Ell grass	Zinc	33.4	MG/KG	Cellular	NOED	NS	Root		NS	NS	Total chlorophyll, Botany Bay
2004	MacInnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Ell grass	Zinc	33.4	MG/KG	Cellular	NOED	NS	Root		NS	NS	Total chlorophyll, Sydney Harbor
2004	MacInnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Ell grass	Zinc	35.6	MG/KG	Cellular	NOED	NS	Leaf		NS	NS	Chlorophyll fluorescence, Pittwater
1997	Filho GMA; CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	40	MG/KG	Growth	ED19	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Ulva lactuca	Ulva lactuca	Zinc	40	MG/KG	Growth	ED42	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Ulva lactuca	Ulva lactuca	Zinc	40	MG/KG	Growth	ED45	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade; Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	40	MG/KG	Growth	ED18	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
2004	MacInnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Ell grass	Zinc	43.2	MG/KG	Cellular	NOED	NS	Leaf		NS	NS	Total chlorophyll, Botany Bay
2004	MacInnis-Ng CMO and PJ Ralph	Jnl Exp Mar Biol & Ecol 302:63-83	Zostera capricorni	Ell grass	Zinc	43.2	MG/KG	Cellular	NOED	NS	Leaf		NS	NS	Total chlorophyll, Sydney Harbor, although Sydney H. demonstrated initial effects, they were non existent by 96 h eventhough highest metals occurred Sydney>Pittwater>Botany Bay
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Enteromorpha flexuosa	Enteromorpha flexuosa	Zinc	60	MG/KG	Growth	ED27	Water	Whole Body	NA	Not Specified	Other	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA; CS Karez, LR Andrade, Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Hypnea musciformis	Hypnea musciformis	Zinc	60	MG/KG	Growth	ED90	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez; LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	60	MG/KG	Growth	ED45	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Enteromorpha flexuosa	Enteromorpha flexuosa	Zinc	100	MG/KG	Growth	ED41	Water	Whole Body	NA	Not Specified	Other	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	100	MG/KG	Growth	ED86	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	100	MG/KG	Growth	ED26	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez; LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	100	MG/KG	Growth	ED13	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA; CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Ulva lactuca	Ulva lactuca	Zinc	120	MG/KG	Growth	ED50	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	120	MG/KG	Growth	ED29	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Sargassum filipendula	Sargassum filipendula	Zinc	140	MG/KG	Growth	ED31	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Hypnea musciformis	Hypnea musciformis	Zinc	140	MG/KG	Growth	ED88	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	140	MG/KG	Growth	ED27	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Ulva lactuca	Ulva lactuca	Zinc	156	MG/KG	Growth	ED50	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade; Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	160	MG/KG	Growth	ED81	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Sargassum filipendula	Sargassum filipendula	Zinc	160	MG/KG	Growth	ED36	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Hypnea musciformis	Hypnea musciformis	Zinc	160	MG/KG	Growth	ED86	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	160	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Total Mass
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	160	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Total Leaf Area
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	160	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Seedling Height
2002	MacFarlane, G.R. and M.D. Burchett	Mar Environ Res 54, 65-84	Avicennia marina	Grey Mangrove	Zinc	160	MG/KG	Growth	LOED	Combined	Root	Yearling	Littoral		Emergence.
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Enteromorpha flexuosa	Enteromorpha flexuosa	Zinc	180	MG/KG	Growth	ED48	Water	Whole Body	NA	Not Specified	Other	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Ulva lactuca	Ulva lactuca	Zinc	180	MG/KG	Growth	ED61	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA; CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	180	MG/KG	Growth	ED83	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	200	MG/KG	Growth	ED70	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc; brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Sargassum filipendula	Sargassum filipendula	Zinc	400	MG/KG	Growth	ED53	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc: brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Sargassum filipendula	Sargassum filipendula	Zinc	400	MG/KG	Growth	ED62	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Sargassum filipendula	Sargassum filipendula	Zinc	400	MG/KG	Growth	ED73	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade, Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Padina gymnospora	Padina gymnospora	Zinc	600	MG/KG	Growth	ED89	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc: brown algae absorbe the most zinc, though growth was impacted in all species

Table E-7
ERED Results for Benthic Organsims: Zinc

Year	Author	Publication Source	Species Scientific Name	Species Common Name	Analyte Name	Conc_Wet	Conc_Units	Effect Class	Toxicity Measure	Exposure Route	Species Body Part	Species Start Lifestage	Species Habitat	Species Feeding Behavior	Comments
1997	Filho GMA; CS Karez, LR Andrade Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	600	MG/KG	Growth	ED71	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc brown algae absorbe the most zinc though growth was impacted in all species
1997	Filho GMA; CS Karez; LR Andrade, Y Yoneshigue-Valentin, WC Pfeiffer	Ecotoxicol Environ Saf 37:2223-228	Spyridia filamentosa	Spyridia filamentosa	Zinc	1000	MG/KG	Growth	ED73	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc though growth was impacted in all species
1997	Filho GMA CS Karez, LR Andrade Y Yoneshigue-Valentin; WC Pfeiffer	Ecotoxicol Environ Sal 37 2223-228	Padina gymnospora	Padina gymnospora	Zinc	1600	MG/KG	Growth	ED92	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc, brown algae absorbe the most zinc, though growth was impacted in all species
1997	Filho GMA, CS Karez, LR Andrade Y Yoneshigue Valentin; WC Pfeiffer	Ecotoxicol Environ Sal 37 2223-228	Padina gymnospora	Padina gymnospora	Zinc	1800	MG/KG	Growth	ED91	Water	Whole Body	NA	Aquatic	Photosynthesis	Algal plants accumulate zinc brown algae absorbe the most zinc, though growth was impacted in all species

ATTACHMENT F

CALCULATION OF PEC QUOTIENTS

Table F-1
PEC-Quotients for Metals (mg/kg) in Sediment Samples
Old American Zinc Plant Site, Fairmont City, Illinois

Facility Drainage Ditch Investigative Samples

Sample ID:		SD-01-0.5		SD-02-0.5		SD-05-0.5		SD-06-0.5		SD-07-0.5		SD-07-0.5/FD		SD-23-0.5		SD-23-0.5/FD		SD-24-0.5		SD-25-0.5		SD-25-0.5/FD		SD-26-0.5		SD-27-0.5		SD-28-0.5	
Date Collected:		5/31/2006		5/31/2006		5/31/2006		5/31/2006		6/2/2006		6/2/2006		6/2/2006		6/2/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Location	PEC	East Ditch 1	PEC-Q	East Ditch 2	PEC-Q	East Ditch 1	PEC-Q	East Ditch 1	PEC-Q	West Ditch 2	PEC-Q	West Ditch 2	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q	West Ditch 1	PEC-Q
Arsenic	33	17	0.52	9.3	0.28	130	3.94	8.5	0.26	98	2.97	45	1.36	78	2.36	81	2.45	130	3.94	9.3	0.28	60	1.82	24	0.73	29	0.88	27	0.82
Barium	--	240	--	320	--	480	--	200	--	87	--	75	--	270	--	290	--	610	--	120	--	480	--	230	--	400	--	200	--
Cadmium	5	130	26.00	24	4.80	270	54.00	61	12.20	37	7.40	37	7.40	130	26.00	120	24.00	630	126.00	27	5.40	650	130.00	64	12.80	61	12.20	51	10.20
Chromium	110	33	0.30	50	0.45	24	0.22	14	0.13	11	0.10	10	0.09	21	0.19	24	0.22	61	0.55	17	0.15	69	0.63	19	0.17	15	0.14	16	0.15
Copper	150	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
Lead	130	870	6.69	440	3.38	3,300	25.38	100	0.77	2,200	16.92	1,800	13.85	1,700	13.08	1,800	13.85	5,600	43.08	3,300	25.38	3,000	23.08	810	6.23	980	7.54	730	5.62
Selenium	--	4.5	--	1.9	--	5.4	--	1.7	--	1.6	--	0.92	--	1.9	--	2.7	--	7.2	--	2.1	--	7.8	--	1.3	--	1.8	--	1.1	--
Silver	2.2	29	13.18	1.9	0.86	64	29.09	1.2	0.55	13	5.91	9.7	4.41	13	5.91	14	6.36	33	15.00	3.6	1.64	40	18.18	3.8	1.73	3.2	1.45	5.1	2.32
Zinc	460	10,000	21.74	1,800	3.91	18,000	39.13	2,600	5.65	33,000	71.74	23,000	50.00	14,000	30.43	15,000	32.61	40,000	86.96	6,800	14.78	95,000	206.52	21,000	45.65	20,000	43.48	15,000	32.61
Mercury	1.1	6.1	5.55	1.0	0.91	8.8	8.00	2.2	2.00	0.57	0.52	0.96	0.87	1.4	1.27	1.2	1.09	0.93	0.85	0.17	0.15	6.3	5.73	0.24	0.22	0.16	0.15	0.33	0.30
Mean PEC-Q metals*			11.0		2.6		24.5		3.8		19.8		14.5		14.4		14.6		52.1		9.2		72.4		13.1		12.8		9.9

Rose Creek Investigative Samples

Sample ID:		SD-08-0.5		SD-09-0.5		SD-41		SD-41-D		SD-42		SD-10-0.5		SD-11-0.5		SD-12-0.5		SD-12/FD		SD-13-0.5		SD-43		SD-44	
Date Collected:		5/31/2006		5/30/2006		12/12/2006		12/12/2006		12/12/2006		6/12/2006		6/12/2006		6/12/2006		6/12/2006		6/12/2006		12/12/2006		12/12/2006	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0.0 - 0.5'		0 - 0.5		0 - 0.5		0 - 0.5	
Location	PEC	Rose Creek (at-site)	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q	Rose Creek	PEC-Q
Arsenic	33	29	0.88	60	1.82	94	2.85	61	1.85	72	2.18	23	0.70	10	0.30	6.0	0.18	6.8	0.21	140	4.24	16	0.48	120	3.64
Barium	--	380	--	150	--	180	--	160	--	200	--	150	--	140	--	160	--	140	--	290	--	270	--	300	--
Cadmium	5	460	92.00	100	20.00	160	32.00	170	34.00	510	102.00	180	36.00	29	5.80	28	5.60	39	7.80	100	20.00	130	26.00	79	15.80
Chromium	110	74	0.67	32	0.29	58	0.53	27	0.25	33	0.30	24	0.22	33	0.30	23	0.21	29	0.26	31	0.28	71	0.65	31	0.28
Copper	150	na	na	na	na	1,100	7.33	780	5.20	950	6.33	na	na	na	na	na	na	na	na	na	na	160	1.07	100	0.67
Lead	130	1,700	13.08	1,800	13.85	4,100	31.54	2,600	20.00	2,700	20.77	860	6.62	300	2.31	120	0.92	190	1.46	680	5.23	580	4.46	750	5.77
Selenium	--	5.5	--	3.4	--	5.9	--	4.6	--	5.2	--	2.7	--	1.5	--	0.7	--	0.7	--	2.4	--	1.9	--	2.4	--
Silver	2.2	17	7.73	10	4.55	19	8.64	13	5.91	18	8.18	6.1	2.77	1.2	0.55	0.45	0.20	0.72	0.33	1.8	0.82	3.0	1.36	3.7	1.68
Zinc	460	25,000	54.35	15,000	32.61	31,000	67.39	24,000	52.17	1,200	2.61	13,000	28.26	4,800	10.43	2,300	5.00	3,400	7.39	9,200	20.00	7,300	15.87	5,300	11.52
Mercury	1.1	6.4	5.82	1.9	1.73	1.6	1.45	0.92	0.84	2.8	2.55	1.5	1.36	0.66	0.60	0.25	0.23	0.33	0.30	1.0	0.91	3.4	3.09	2.7	2.45
Mean PEC-Q metals*			32.2		13.7		23.6		18.9		22.4		14.4		3.8		2.4		3.4		10.0		8.1		6.3

Rose Creek Upstream Samples

Sample ID:		SD-03-0.5		SD-04-0.5		RSD-1		RSD-2		RSD-3		RSD-4	
Date Collected:		6/1/2006		6/1/2006		7/17/2007		7/17/2007		7/17/2007		7/17/2007	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0-0.5 (0-6")		0-0.5 (0-6")		0-0.5 (0-6")		0-0.5 (0-6")	
Location	PEC	Ditch along Kingshwy	PEC-Q	Rose Creek (upstream)	PEC-Q	Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	PEC-Q	Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical	PEC-Q	Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	PEC-Q	Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	PEC-Q
Arsenic	33	10	0.30	6.7	0.20	16	0.48	21	0.64	4.9	0.15	23	0.70
Barium	--	150	--	190	--	240	--	320	--	120	--	380	--
Cadmium	5	38	7.60	6.5	1.30	4.9	0.98	9.9	1.98	5	1.00	9.9	1.98
Chromium	110	26	0.24	60	0.55	53	0.48	59	0.54	90	0.82	91	0.83
Copper	150	na	na	na	na	210	1.40	250	1.67	140	0.93	340	2.27
Lead	130	520	4.00	280	2.15	620	4.77	780	6.00	380	2.92	630	4.85
Selenium	--	0.97	--	3.3	--	2.7	--	2.1	--	0.73	--	2.3	--
Silver	2.2	2.5	1.14	1.0	0.45	2.1	0.95	2.3	1.05	2.4	1.09	2.9	1.32
Zinc	460	3,900	8.48	1,100	2.39	710	1.54	1300	2.83	820	1.78	1600	3.48
Mercury	1.1	0.32	0.29	0.26	0.24	5.3	4.82	4.1	3.73	0.0068	0.01	4.1	3.73
Mean PEC-Q metals*			4.1		1.3		1.6		2.3		1.3		2.3

Rose Creek Outfall Investigative Samples

Sample ID:		SD-14-0.5		SD-15-0.5		SD-16-0.5		SD-17-0.5		SD-18-0.5		TRC-2-S-0-6		TRC-2-S-8-10		TRC-2-S-12-14		TRC-2-S1-0-6	
Date Collected:		6/12/2006		6/12/2006		6/12/2006		6/12/2006		6/12/2006		7/18/2007		7/18/2007		7/18/2007		7/19/2007	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5 (0-6")		0.66 - 0.83 (8-10")		1.0 - 1.16 (12-14")		0 - 0.5 (0-6")	
Location	PEC	Rose Creek Outfall	PEC-Q	Rose Creek Outfall	PEC-Q	Rose Creek Outfall	PEC-Q	Rose Creek Outfall	PEC-Q	Rose Creek Outfall	PEC-Q	Old Cahokia Watershed [6]	PEC-Q	Old Cahokia Watershed [6]	PEC-Q	Old Cahokia Watershed [6]	PEC-Q	Old Cahokia Watershed [6]	PEC-Q
Arsenic	33	10	0.30	9.7	0.29	8.2	0.25	20	0.61	9.5	0.29	160	4.85	360	10.91	570	17.27	61	1.85
Barium	--	310	--	250	--	220	--	120	--	250	--	400	--	490	--	660	--	320	--
Cadmium	5	12	2.40	7.4	1.48	1.1	0.22	15	3.00	26	5.20	1,300	260.00	2,100	420.00	140	28.00	290	58.00
Chromium	110	23	0.21	21	0.19	19	0.17	16	0.15	22	0.20	63	0.57	80	0.73	110	1.00	48	0.44
Copper	150	na	na	na	na	na	na	na	na	na	na	430	2.87	520	3.47	2,500	16.67	460	3.07
Lead	130	430	3.31	230	1.77	33	0.25	160	1.23	210	1.62	1,600	12.31	2,100	16.15	5,500	42.31	1,200	9.23
Selenium	--	0.72	--	1.2	--	0.7	--	0.56	--	1.2	--	10	--	12	--	25	--	5.6	--
Silver	2.2	0.64	0.29	0.35	0.16	0.24	0.11	0.35	0.16	0.64	0.29	12	5.45	15	6.82	55	25.00	12	5.45
Zinc	460	1,100	2.39	740	1.61	140	0.30	1,700	3.70	810	1.76	15,000	32.61	20,000	43.48	6,600	14.35	8,600	18.70
Mercury	1.1	0.29	0.26	0.26	0.24	0.078	0.07	0.46	0.42	0.45	0.41	11	10.00	14	12.73	120	109.09	3.4	3.09
Mean PEC-Q metals*			1.7		1.1		0.24		1.7		1.8		52.20		82.46		19.93		15.2

West Ditch Outfall Investigative Samples

Sample ID:		SD-29-0.5		SD-30-0.5		SD-31-0.5		SD-32-0.5		SD-33-0.5		SD-034		SD-034-D		SD-38		SD-39		SD-40	
Date Collected:		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/28/2006		6/28/2006		12/12/2006		12/12/2006		12/12/2006	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Location	PEC	West Ditch 1 Outfall	PEC-Q	West Ditch 1 Outfall	PEC-Q	West Ditch 1 Outfall	PEC-Q	West Ditch 1 Outfall	PEC-Q	West Ditch 1 Outfall	PEC-Q	Cahokia Watershed [3]	PEC-Q	Cahokia Watershed [3]	PEC-Q	Cahokia Watershed [4]	PEC-Q	Cahokia Watershed [4]	PEC-Q	Cahokia Watershed [4]	PEC-Q
Arsenic	33	11	0.33	13	0.39	8.0	0.24	25	0.76	5	0.15	15	0.45	17	0.52	15	0.45	20	0.61	11	0.33
Barium	--	190	--	180	--	220	--	270	--	140	--	210	--	230	--	220	--	120	--	140	--
Cadmium	5	43	8.60	72	14.40	32	6.40	69	13.80	6.6	1.32	300	60.00	380	76.00	140	28.00	25	5.00	99	19.80
Chromium	110	15	0.14	17	0.15	14	0.13	22	0.20	9.6	0.09	17	0.15	21	0.19	21	0.19	15	0.14	14	0.13
Copper	150	na	na	na	na	na	na	na	na	na	na	na	na	na	na	1,100	7.33	260	1.73	320	2.13
Lead	130	380	2.92	510	3.92	52	0.40	870	6.69	46	0.35	440	3.38	550	4.23	340	2.62	240	1.85	190	1.46
Selenium	--	0.83	--	0.95	--	0.89	--	1.3	--	0.5	--	1.85	--	2.5	--	4.85	--	4.85	--	4.65	--
Silver	2.2	1.4	0.64	1.8	0.82	0.24	0.11	4	1.82	0.25	0.11	3.0	1.36	3.4	1.55	3.0	1.36	2.1	0.95	1.1	0.50
Zinc	460	4,000	8.70	3,800	8.26	7,900	17.17	6,400	13.91	590	1.28	35,000	76.09	43,000	93.48	14,000	30.43	3,500	7.61	8,900	19.35
Mercury	1.1	0.11	0.10	0.14	0.13	0.042	0.04	0.19	0.17	0.034	0.03	0.31	0.28	0.18	0.16	0.27	0.25	0.105	0.10	0.085	0.08
Mean PEC-Q metals*			4.1		5.4		4.9		7.1		0.64		28.0		34.9		11.5		2.8		7.2

Sample ID:		SD-45		SD-46		SD-47		SD-48		TWD-02-C-0-6		TWD-02-C-6-9		TWD-02-C-6-9 DUP		TWD-02-S-0-6		TWD-02-S-6-8	
Date Collected:		12/12/2006		12/13/2006		12/13/2006		12/13/2006		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007	
Depth (ft - ft)		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5 (0-6")		0.5 - 0.75 (6-9")		0.5 - 0.75 (6-9")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8")	
Location	PEC	Cahokia Wetland [2]	PEC-Q	Cahokia Wetland [2]	PEC-Q	Cahokia Wetland [2]	PEC-Q	Cahokia Wetland [2]	PEC-Q	Old Cahokia Watershed [5]	PEC-Q	Old Cahokia Watershed [5]	PEC-Q	Old Cahokia Watershed [5]	PEC-Q	Old Cahokia Watershed [5]	PEC-Q	Old Cahokia Watershed [5]	PEC-Q
Arsenic	33	15	0.45	19	0.58	19	0.58	25	0.76	15	0.45	5.4	0.16	4.6	0.14	5.9	0.18	7.8	0.24
Barium	--	210	--	250	--	220	--	210	--	200	--	310	--	280	--	320	--	460	--
Cadmium	5	56	11.20	150	30.00	90	18.00	89	17.80	71	14.20	17	3.40	12	2.40	140	28.00	34	6.80
Chromium	110	19	0.17	21	0.19	17	0.15	21	0.19	28	0.25	32	0.29	33	0.30	31	0.28	32	0.29
Copper	150	1,800	12.00	4,200	28.00	3,400	22.67	5,300	35.33	340	2.27	66	0.44	61	0.41	790	5.27	91	0.61
Lead	130	220	1.69	590	4.54	420	3.23	670	5.15	210	1.62	160	1.23	120	0.92	260	2.00	210	1.62
Selenium	--	1.1	--	1.8	--	1.4	--	1.9	--	1.8	--	0.7	--	1.1	--	1.05	--	0.75	--
Silver	2.2	1.2	0.55	3.6	1.64	2.2	1.00	4.6	2.09	1	0.45	0.56	0.25	0.37	0.17	1.2	0.55	0.52	0.24
Zinc	460	16,000	34.78	23,000	50.00	25,000	54.35	26,000	56.52	12,000	26.09	1,900	4.13	1,900	4.13	16,000	34.78	3,700	8.04
Mercury	1.1	0.11	0.10	0.32	0.29	0.19	0.17	0.36	0.33	0.15	0.14	0.079	0.07	0.087	0.08	0.13	0.12	0.095	0.09
Mean PEC-Q metals*			10.1		18.9		16.5		19.3		7.5		1.6		1.4		11.8		2.9

Notes:
*Black **BOLD** values indicate ts detected concentration; nond-detects presented at 1/2 SQL.*

na: not analyzed
** Denotes background samples*
Sch. Creek = Schoenberger Creek
[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed.
[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.
[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34).
[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area
[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area.

* Based on EPA (2002), only includes arsenic, cadmium, chromium,copper, lead, and zinc.

Table F-1
PEC-Quotients for Metals (mg/kg) in Sediment Samples
Old American Zinc Plant Site, Fairmont City, Illinois

West Ditch Outfall Reference Samples

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	TWD-1-N-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-1-N-6-8 7/17/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [5]	PEC-Q	TWD-1-C-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-1-C-6-10 7/17/2007 0.5 - 0.8 (6-10") Old Cahokia Watershed [5]	PEC-Q	TWD-1-S-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-1-S-6-9.5 7/17/2007 0.5 - 0.75 (6-9.5") Old Cahokia Watershed [5]	PEC-Q
Arsenic	33	7.7	0.23	5.8	0.18	16	0.48	8.5	0.26	7.1	0.22	11	0.33
Barium	--	250	--	250	--	230	--	260	--	420	--	450	--
Cadmium	5	55	11.00	4.1	0.82	44	8.80	16	3.20	90	18.00	15	3.00
Chromium	110	29	0.26	31	0.28	33	0.30	30	0.27	30	0.27	29	0.26
Copper	150	61	0.41	32	0.21	53	0.35	34	0.23	130	0.87	47	0.31
Lead	130	140	1.08	32	0.25	78	0.60	33	0.25	390	3.00	78	0.60
Selenium	--	1.5	--	1.4	--	1.6	--	1.2	--	2	--	1.3	--
Silver	2.2	0.58	0.26	0.3	0.14	0.35	0.16	0.24	0.11	1.5	0.68	0.41	0.19
Zinc	460	2,000	4.35	350	0.76	2,900	6.30	1,800	3.91	4,600	10.00	1,800	3.91
Mercury	1.1	0.070	0.06	0.06	0.05	0.076	0.07	0.068	0.06	0.2	0.18	0.076	0.07
Mean PEC-Q metals*			2.9		0.42		2.8		1.4		5.4		1.4

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	TWD-02-N-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-02-N-6-7 7/17/2007 0.5 - 0.6 (6-7") Old Cahokia Watershed [5]	PEC-Q	TWD-03-N-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-03-N-6-8 7/17/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [5]	PEC-Q	TWD-03-C-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-03-C-6-8.5 7/17/2007 0.5 - 0.66 (6-8.5") Old Cahokia Watershed [5]	PEC-Q	TWD-03-S-0-6 7/17/2007 0 - 0.5 (0-6") Old Cahokia Watershed [5]	PEC-Q	TWD-03-S-6-8 7/17/2007 0.5 - 0.6 (6-8") Old Cahokia Watershed [5]	PEC-Q
Arsenic	33	10	0.30	7	0.21	7.7	0.23	7.1	0.22	7.3	0.22	6.1	0.18	10	0.30	6.2	0.19
Barium	--	250	--	240	--	230	--	220	--	270	--	310	--	210	--	320	--
Cadmium	5	32	6.40	44	8.80	28	5.60	18	3.60	25	5.00	21	4.20	23	4.60	20	4.00
Chromium	110	32	0.29	29	0.26	30	0.27	28	0.25	29	0.26	28	0.25	20	0.18	29	0.26
Copper	150	61	0.41	57	0.38	51	0.34	35	0.23	75	0.50	59	0.39	79	0.53	42	0.28
Lead	130	140	1.08	130	1.00	130	1.00	52	0.40	180	1.38	140	1.08	150	1.15	59	0.45
Selenium	--	1	--	1	--	1	--	1.6	--	2	--	0.69	--	1.6	--	1.2	--
Silver	2.2	0.48	0.22	0.43	0.20	0.49	0.22	0.16	0.07	0.62	0.28	0.5	0.23	0.78	0.35	0.37	0.17
Zinc	460	1800	3.91	1800	3.91	1,900	4.13	1,200	2.61	2,700	5.87	1,300	2.83	2,400	5.22	1,300	2.83
Mercury	1.1	0.073	0.07	0.08	0.07	0.063	0.06	0.055	0.05	0.11	0.10	0.067	0.06	0.1	0.09	0.072	0.07
Mean PEC-Q metals*			2.1		2.4		1.9		1.2		2.2		1.5		2.0		1.3

Rose Creek Outfall Reference Samples

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	SD-50-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Creek	PEC-Q	SD-50-8-10 7/19/2007 0.66 - 0.83 (8-10") Old Cahokia Creek	PEC-Q	SD-51-DITCH-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	PEC-Q	SD-51-DITCH-8-10 7/19/2007 0.66 - 0.83 (8-10") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	PEC-Q	SD-51-DITCH-12-14 7/19/2007 1.0 - 1.16 (12-14") Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill	PEC-Q	TRC-3-S-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-3-S-7-9 7/18/2007 0.58-0.75 (7-9") Old Cahokia Watershed [6]	PEC-Q
Arsenic	33	4.4	0.13	9.4	0.28	75	2.27	110	3.33	79	2.39	12	0.36	4.6	0.14
Barium	--	220	--	250	--	400	--	290	--	520	--	300	--	250	--
Cadmium	5	22	4.40	22	4.40	100	20.00	330	66.00	75	15.00	36	7.20	64	12.80
Chromium	110	18	0.16	20	0.18	49	0.45	110	1.00	59	0.54	43	0.39	26	0.24
Copper	150	29	0.19	41	0.27	98	0.65	160	1.07	600	4.00	230	1.53	170	1.13
Lead	130	58	0.45	92	0.71	300	2.31	650	5.00	1,600	12.31	79	0.61	38	0.29
Selenium	--	1.1	--	1.9	--	3.5	--	4.1	--	14	--	1.4	--	0.85	--
Silver	2.2	0.335	0.15	0.18	0.08	2.2	1.00	3.6	1.64	25	11.36	0.29	0.13	0.43	0.20
Zinc	460	780	1.70	1100	2.39	1,900	4.13	3100	6.74	1,600	3.48	1,100	2.39	1,600	3.48
Mercury	1.1	0.13	0.12	0.077	0.07	2	1.82	5.3	4.82	18	16.36	0.18	0.16	0.073	0.07
Mean PEC-Q metals*			1.2		1.4		5.0		13.9		6.3		2.1		3.0

Impoundment Samples

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	TRC-1-N-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-1-N-6-8 7/18/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	PEC-Q	TRC-1-S-0-6 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-1-S-0-6-D 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-1-S-6-8 7/19/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	PEC-Q	TRC-2-N-0-6 7/18/2007 Old Cahokia Watershed [6]	PEC-Q	TRC-2-N1-0-6 7/17/2007 Old Cahokia Watershed [6]	PEC-Q
Arsenic	33	5.6	0.17	5.3	0.16	19	0.58	19	0.58	6.1	0.18	2.3	0.07	6.9	0.21
Barium	--	330	--	290	--	270	--	340	--	290	--	160	--	170	--
Cadmium	5	13	2.60	4.1	0.82	8.1	1.62	7.4	1.48	7.4	1.48	0.11	0.02	0.125	0.03
Chromium	110	24	0.22	22	0.20	26	0.24	26	0.24	22	0.20	8.3	0.08	14	0.13
Copper	150	37	0.25	28	0.19	36	0.24	35	0.23	25	0.17	6.4	0.04	16	0.11
Lead	130	38	0.29	21	0.16	75	0.58	72	0.55	17	0.13	9	0.07	11	0.08
Selenium	--	1.3	--	1.2	--	1.6	--	1.3	--	1.3	--	0.05	--	0.6	--
Silver	2.2	0.48	0.22	0.405	0.18	0.44	0.20	0.42	0.19	0.415	0.19	0.28	0.13	0.32	0.15
Zinc	460	680	1.48	440	0.96	740	1.61	740	1.61	700	1.52	38	0.08	53	0.12
Mercury	1.1	0.11	0.10	0.052	0.05	0.14	0.13	0.19	0.17	0.034	0.03	0.02	0.02	0.033	0.03
Mean PEC-Q metals*			0.83		0.41		0.81		0.78		0.61		0.06		0.11

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	TRC-2-N1-6-8 7/18/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	PEC-Q	TRC-2-C-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-2-C-10-12 7/18/2007 0.83 - 1.0 (10-12") Old Cahokia Watershed [6]	PEC-Q	TRC-3-N-0-6 7/18/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q	TRC-3-N-0-6/FD 7/18/2007 0.5 - 0.66 (6-8") Old Cahokia Watershed [6]	PEC-Q	TRC-3-N-8-10 7/19/2007 0 - 0.5 (0-6") Old Cahokia Watershed [6]	PEC-Q
Arsenic	33	18	0.55	5.6	0.17	3.7	0.11	1.6	0.05	1.9	0.06	2	0.05
Barium	--	180	--	310	--	250	--	74	--	120	--	49	--
Cadmium	5	0.15	0.03	4.8	0.96	0.26	0.05	0.48	0.10	0.1	0.02	0	0.03
Chromium	110	15	0.14	23	0.21	18	0.16	6	0.05	8.3	0.08	4.6	0.04
Copper	150	15	0.10	31	0.21	22	0.15	6	0.04	7.2	0.05	2.8	0.02
Lead	130	12	0.09	33	0.25	16	0.12	7.1	0.05	9	0.07	4.2	0.03
Selenium	--	1.1	--	1.8	--	0.85	--	0.7	--	0.65	--	0.60	--
Silver	2.2	0.36	0.16	0.22	0.10	0.335	0.15	0.34	0.15	0.32	0.15	0.31	0.14
Zinc	460	54	0.12	240	0.52	79	0.17	42	0.09	47	0.10	19	0.04
Mercury	1.1	0.03	0.02	0.051	0.05	0.042	0.04	0.014	0.01	0.0091	0.01	0.0068	0.01
Mean PEC-Q metals*			0.17		0.39		0.13		0.06		0.06		0.03

Schoenberger Creek Samples

Sample ID: / Date Collected: / Depth (ft - ft) / Location	PEC	SD-20-0.5 6/13/2006 0 - 0.5 Sch. Creek	PEC-Q	SD-20-0.5/FD 6/13/2006 0.0 - 0.5 Sch. Creek	PEC-Q	SD-21-0.5 6/12/2006 0 - 0.5 Sch. Creek	PEC-Q	SD-36 6/29/2006 0 - 0.5 Sch. Creek	PEC-Q	SD-037 6/29/2006 0 - 0.5 Sch. Creek	PEC-Q	SD-22-0.5 6/13/2006 0 - 0.5 Sch. Creek	PEC-Q	SD-52 7/19/2007 0 - 0.5 (0-6") Schoenberger Creek - west of Old Cahokia western boundary	PEC-Q
Arsenic	33	12	0.36	12	0.36	13	0.39	13	0.39	15	0.45	12	0.36	26	0.79
Barium	--	510	--	480	--	510	--	270	--	340	--	640	--	260	--
Cadmium	5	23	0.13	23	0.13	27	0.15	19	0.10	44	0.24	21	0.11	80	0.43
Chromium	110	120	1.09	99	0.90	110	1.00	53	0.48	230	2.09	250	2.27	630	5.73
Copper	150	na	na	na	na	na	na	na	na	na	na	na	na	75	0.50
Lead	130	170	1.31	150	1.15	160	1.23	70	0.54	150	1.15	230	1.77	180	1.38
Selenium	--	1.25	--	1.9	--	1.35	--	0.89	--	1.8	--	1.3	--	1.7	--
Silver	2.2	0.72	0.33	0.57	0.26	0.67	0.30	0.23	0.10	0.96	0.44	0.86	0.39	1.1	0.50
Zinc	460	1,000	2.17	930	2.02	980	2.13	750	1.63	1,100	2.39	940	2.04	1,800	3.91
Mercury	1.1	0.51	0.46	0.63	0.57	0.38	0.35	0.22	0.20	0.25	0.23	0.30	0.27	0.15	0.14
Mean PEC-Q metals*			1.0		0.91		1.0		0.63		1.3		1.3		2.1

Notes:
*Black **BOLD** values indicate ts detected concentration; nond-detects presented at 1/2 SQL.*

na: not analyzed
** Denotes background samples*
Sch. Creek = Schoenberger Creek
[2] - Sample collected in wet meadow (wetland) between West Ditch Outfall and open water habitat in the Cahokia Creek Watershed.
[3] - Samples collected at southern edge of open water habitat in the Cahokia Creek watershed.
[4] - Reference samples were collected in the open water habitat of the Old Cahokia Creek Watershed (northeast of SW-34).
[5] - Open water area in western portion of the Old Cahokia Creek Watershed beyond West Ditch discharge area
[6] - Wetland and wet meadow area in western half of Old Cahokia Creek Watershed beyond Rose Creek discharge area.

* Based on EPA (2002), only includes arsenic, cadmium, chromium,copper, lead, and zinc.

Table F-2
Estimated Benthic Invertebrate Tissue Concentrations for Cadmium, Lead, and Zinc at all Sediment Sample Locations
Old American Zinc Plant Site, Fairmont City, Illinois

Facility Drainage Ditch Investigative Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-02-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-07-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-07-0.5/FD	Estimated Tissue Concentration (mg/kg wet)[c]	SD-23-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-23-0.5/FD	Estimated Tissue Concentration (mg/kg wet)[c]	SD-24-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-25-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-25-0.5/FD	Estimated Tissue Concentration (mg/kg wet)[c]	SD-26-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-27-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-28-0.5	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			5/31/2006		6/2/2006		6/2/2006		6/2/2006		6/2/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Location			East Ditch 2		West Ditch 2		West Ditch 2		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1		West Ditch 1	
Cadmium	0.00393	0.59	24	0.02	37	0.02	37	0.02	130	0.09	120	0.08	630	0.41	27	0.02	650	0.43	64	0.04	61	0.04	51	0.03
Lead	0.00121	5.22	440	0.09	2,200	0.44	1,800	0.36	1,700	0.34	1,800	0.36	5,600	1.13	3,300	0.67	3,000	0.61	810	0.16	980	0.20	730	0.15
Zinc	0.00355	11.12	1,800	1.07	33,000	19.56	23,000	13.64	14,000	8.30	15,000	8.89	40,000	23.71	6,800	4.03	95,000	56.32	21,000	12.45	20,000	11.86	15,000	8.89

Rose Creek Investigative Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-09-0.5	Concentration	SD-41	Concentration	SD-41-D	Estimated Tissue Concentration (mg/kg wet)[c]	SD-42	Estimated Tissue Concentration (mg/kg wet)[c]	SD-10-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-11-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-12-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-12/FD	Estimated Tissue Concentration (mg/kg wet)[c]	SD-43	Tissue	SD-44	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			5/30/2006		12/12/2006		12/12/2006		12/12/2006		6/12/2006		6/12/2006		6/12/2006		6/12/2006		12/12/2006		12/12/2006	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0.0 - 0.5'		0 - 0.5		0 - 0.5	
Location			Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek		Rose Creek	
Cadmium	0.00393	0.59	100	0.07	160	0.11	170	0.11	510	0.33	180	0.12	29	0.02	28	0.02	39	0.03	130	0.09	79	0.05
Lead	0.00121	5.22	1,800	0.36	4,100	0.83	2,600	0.53	2,700	0.55	860	0.17	300	0.06	120	0.02	190	0.04	580	0.12	750	0.15
Zinc	0.00355	11.12	15,000	8.89	31,000	18.38	24,000	14.23	1,200	0.71	13,000	7.71	4,800	2.85	2,300	1.36	3,400	2.02	7,300	4.33	5,300	3.14

Rose Creek Upstream Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-03-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-04-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	RSD-1	Estimated Tissue Concentration (mg/kg wet)[c]	RSD-2	Estimated Tissue Concentration (mg/kg wet)[c]	RSD-3	Estimated Tissue Concentration (mg/kg wet)[c]	RSD-4	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			6/1/2006		6/1/2006		7/17/2007		7/17/2007		7/17/2007		7/17/2007	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0-0.5 (0-6")		0-0.5 (0-6")		0-0.5 (0-6")		0-0.5 (0-6")	
Location			Ditch along Kingshwy		Rose Creek (upstream)		Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical		Rose Creek - Upstream of Facility, east of Kingshighway & south of General Chemical		Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem		Rose Creek - Upstream of Facility, west of Kingshighway & south of Former Swift Ag Chem	
Cadmium	0.00393	0.59	38	0.02	6.5	0.004	4.9	0.003	9.9	0.01	5	0.003	9.9	0.01
Lead	0.00121	5.22	520	0.11	280	0.06	620	0.13	780	0.16	380	0.08	630	0.13
Zinc	0.00355	11.12	3,900	2.31	1,100	0.65	710	0.42	1300	0.77	820	0.49	1600	0.95

Rose Creek Outfall Investigative Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-14-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-15-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-16-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-17-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-18-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-S-8-10	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-S-12-14	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-S1-0-6	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			6/12/2006		6/12/2006		6/12/2006		6/12/2006		6/12/2006		7/18/2007		7/18/2007		7/18/2007		7/19/2007	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5 (0-6")		0.66 - 0.83 (8-10")		1.0 - 1.16 (12-14")		0 - 0.5 (0-6")	
Location			Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Rose Creek Outfall		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]	
Cadmium	0.00393	0.59	12	0.01	7.4	0.005	1.1	0.001	15	0.01	26	0.02	1,300	0.85	2,100	1.38	140	0.09	290	0.19
Lead	0.00121	5.22	430	0.09	230	0.05	33	0.01	160	0.03	210	0.04	1,600	0.32	2,100	0.42	5,500	1.11	1,200	0.24
Zinc	0.00355	11.12	1,100	0.65	740	0.44	140	0.08	1,700	1.01	810	0.48	15,000	8.89	20,000	11.86	6,600	3.91	8,600	5.10

West Ditch Outfall Investigative Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-29-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-30-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-31-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-32-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-33-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-38	Tissue	SD-39	Estimated Tissue Concentration (mg/kg wet)[c]	SD-40	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			6/1/2006		6/1/2006		6/1/2006		6/1/2006		6/1/2006		12/12/2006		12/12/2006		12/12/2006	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Location			West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		West Ditch 1 Outfall		Cahokia Watershed [4]		Cahokia Watershed [4]		Cahokia Watershed [4]	
Cadmium	0.00393	0.59	43	0.03	72	0.05	32	0.02	69	0.05	6.6	0.004	140	0.09	25	0.02	99	0.06
Lead	0.00121	5.22	380	0.08	510	0.10	52	0.01	870	0.18	46	0.01	340	0.07	240	0.05	190	0.04
Zinc	0.00355	11.12	4,000	2.37	3,800	2.25	7,900	4.68	6,400	3.79	590	0.35	14,000	8.30	3,500	2.07	8,900	5.28

West Ditch Outfall Investigative Samples (continued)

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-45	Estimated Tissue Concentration (mg/kg wet)[c]	SD-46	Estimated Tissue Concentration (mg/kg wet)[c]	SD-47	Estimated Tissue Concentration (mg/kg wet)[c]	SD-48	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-C-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-C-6-9	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-C-6-9 DUP	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-S-6-8	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			12/12/2006		12/13/2006		12/13/2006		12/13/2006		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007	
Depth (ft - ft)			0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5 (0-6")		0.5 - 0.75 (6-9")		0.5 - 0.75 (6-9")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8")	
Location			Cahokia Wetland [2]		Cahokia Wetland [2]		Cahokia Wetland [2]		Cahokia Wetland [2]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]	
Cadmium	0.00393	0.59	56	0.04	150	0.10	90	0.06	89	0.06	71	0.05	17	0.01	12	0.01	140	0.09	34	0.02
Lead	0.00121	5.22	220	0.04	590	0.12	420	0.08	670	0.14	210	0.04	160	0.03	120	0.02	260	0.05	210	0.04
Zinc	0.00355	11.12	16,000	9.49	23,000	13.64	25,000	14.82	26,000	15.41	12,000	7.11	1,900	1.13	1,900	1.13	16,000	9.49	3,700	2.19

West Ditch Outfall Reference Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	TWD-1-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-1-N-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-1-C-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-1-C-6-10	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-1-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-1-S-6-9.5	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-02-N-6-7	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-N-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-C-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-C-6-8.5	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-S-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TWD-03-S-10-12	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007		7/17/2007	
Depth (ft - ft)			0 - 0.5 (0-6")		0.5 - 0.66 (6-8")		0 - 0.5 (0-6")		0.5 - 0.8 (6-10")		0 - 0.5 (0-6")		0.5 - 0.75 (6-9.5")		0 - 0.5 (0-6")		0.5 - 0.6 (6-7")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8.5")		0 - 0.5 (0-6")		0.5 - 0.6 (6-8")		0.83 - 1.0 (10-12")	
Location			Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]		Old Cahokia Watershed [5]	
Cadmium	0.00393	0.59	55	0.04	4.1	0.003	44	0.03	16	0.01	90	0.06	15	0.01	32	0.02	44	0.03	28	0.02	18	0.01	25	0.02	21	0.01	23	0.02	20	0.01	19	0.01
Lead	0.00121	5.22	140	0.03	32	0.01	78	0.02	33	0.01	390	0.08	78	0.02	140	0.03	130	0.03	130	0.03	52	0.01	180	0.04	140	0.03	150	0.03	59	0.01	48	0.01
Zinc	0.00355	11.12	2,000	1.19	350	0.21	2,900	1.72	1,800	1.07	4,600	2.73	1,800	1.07	1800	1.07	1800	1.07	1,900	1.13	1,200	0.71	2,700	1.60	1,300	0.77	2,400	1.42	1,300	0.77	1,300	0.77

Rose Creek Outfall Reference Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-50-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	SD-50-8-10	Estimated Tissue Concentration (mg/kg wet)[c]	SD-51-DITCH-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	SD-51-DITCH-8-10	Estimated Tissue Concentration (mg/kg wet)[c]	SD-51-DITCH-12-14	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-3-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-3-S-7-9	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			7/19/2007		7/19/2007		7/19/2007		7/19/2007		7/19/2007		7/19/2007		7/18/2007	
Depth (ft - ft)			0 - 0.5 (0-6")		0.66 - 0.83 (8-10")		0 - 0.5 (0-6")		0.66 - 0.83 (8-10")		1.0 - 1.16 (12-14")		0 - 0.5 (0-6")		0.58-0.75 (7-9")	
Location			Old Cahokia Creek		Old Cahokia Creek		Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed - upgradient of Rose Creek discharge area, adj to Milam Landfill		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]	
Cadmium	0.00393	0.59	22	0.01	22	0.01	100	0.07	330	0.22	75	0.05	36	0.02	64	0.04
Lead	0.00121	5.22	58	0.01	92	0.02	300	0.06	650	0.13	1,600	0.32	79	0.02	38	0.01
Zinc	0.00355	11.12	780	0.46	1100	0.65	1,900	1.13	3100	1.84	1,600	0.95	1,100	0.65	1,600	0.95

Impoundment Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	TRC-1-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-1-N-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-1-S-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-1-S-0-6-D	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-1-S-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-N1-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-N1-6-8	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-C-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-2-C-10-12	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-3-N-0-6	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-3-N-0-6/FD	Estimated Tissue Concentration (mg/kg wet)[c]	TRC-3-N-8-10	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			7/18/2007		7/18/2007		7/19/2007		7/19/2007		7/19/2007		7/18/2007		7/17/2007		7/18/2007		7/18/2007		7/18/2007		7/18/2007		7/18/2007		7/19/2007	
Depth (ft - ft)			0 - 0.5 (0-6")		0.5 - 0.66 (6-8")		0 - 0.5 (0-6")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8")						0.5 - 0.66 (6-8")		0 - 0.5 (0-6")		0.83 - 1.0 (10-12")		0 - 0.5 (0-6")		0.5 - 0.66 (6-8")		0 - 0.5 (0-6")	
Location			Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]		Old Cahokia Watershed [6]	
Cadmium	0.00393	0.59	13	0.01	4.1	0.003	8.1	0.01	7.4	0.005	7.4	0.005	0.11	0.0001	0.125	0.0001	0.15	0.0001	4.8	0.0032	0.26	0.0002	0.48	0.0003	0.1	0.0001	0.13	0.0001
Lead	0.00121	5.22	38	0.01	21	0.004	75	0.02	72	0.01	17	0.003	9	0.0018	11	0.0022	12	0.0024	33	0.0067	16	0.0032	7.1	0.0014	9	0.0018	4.2	0.0008
Zinc	0.00355	11.12	680	0.40	440	0.26	740	0.44	740	0.44	700	0.41	38	0.02	53	0.03	54	0.03	240	0.14	79	0.05	42	0.02	47	0.03	19	0.01

Schoenberger Creek Samples

Sample ID:	Site-Specific Uptake Factor[a]	LOEC TISSUE RESIDUE EFFECT LEVEL[b] (mg/kg wet)	SD-20-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-20-0.5/FD	Estimated Tissue Concentration (mg/kg wet)[c]	SD-21-0.5	Estimated Tissue Concentration (mg/kg wet)[c]	SD-52	Estimated Tissue Concentration (mg/kg wet)[c]
Date Collected:			6/13/2006		6/13/2006		6/12/2006		7/19/2007	
Depth (ft - ft)			0 - 0.5		0.0 - 0.5		0 - 0.5		0 - 0.5 (0-6")	
Location			Sch. Creek		Sch. Creek		Sch. Creek		Schoenberger Creek - west of Old Cahokia western boundary	
Cadmium	0.00393	0.59	23	0.02	23	0.02	27	0.02	80	0.05
Lead	0.00121	5.22	170	0.03	150	0.03	160	0.03	180	0.04
Zinc	0.00355	11.12	1,000	0.59	930	0.55	980	0.58	1,800	1.07

Notes:
a See Figure 5.
b See Table 6-3.
c Tissue was estimates as sediment concentration x site-specific uptake factor (dry weight basis). Percent moisture was not available from the laboratory.
Values were converted to wet tissue weight assuming that benthic invertebrate moisture content of 83.3 (by mass) percent (Pietz et al., 1984, as cited in EPA, 1999).
Ctissue (wet weight) = Ctissue (dry weight) x (1 - % water)